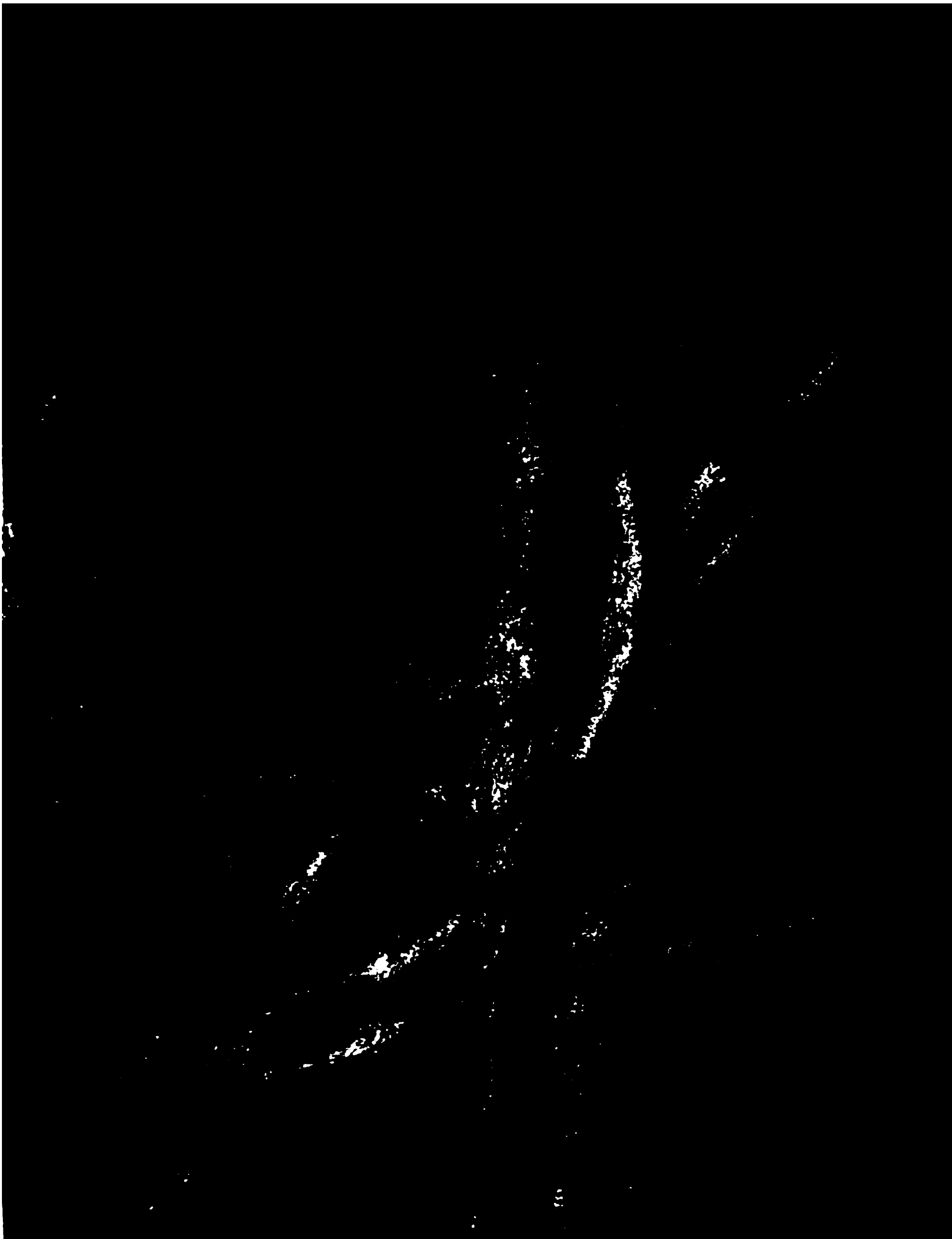

Proceedings of the United States National Museum

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PROCEEDINGS

OF THE

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Volume XVI.

1893.

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ADVERTISEMENT.

The extension of the scope of the National Museum during the past few years and the activity of the collectors employed in its interest have caused a great increase in the amount of material in its possession. Many of the objects gathered are of a novel and important character, and serve to throw a new light upon the study of nature and of man.

The importance to science of prompt publication of descriptions of this material led to the establishment, in 1878, of the present series of publications, entitled "Proceedings of the United States National Museum," the distinguishing peculiarity of which is that the articles are published in pamphlet form as fast as completed and in advance of the bound volume. The present volume constitutes the sixteenth ot the series.

The articles in this series consist: First, of papers prepared by the scientific corps of the National Museum; secondly, of papers by others, founded upon the collections in the National Museum; and, finally, of facts and memoranda from the correspondence of the Smithsonian Institution.

The Bulletin of the National Museum, the publication of which was commenced in 1875, consists of elaborate papers based upon the collections of the Museum, reports of expeditions, etc., while the Proceedings facilitate the prompt publication of freshly-acquired facts relating to biology, anthropology and geology, descriptions of restricted groups of animals and plants, the discussion of particular questions relative to the synonymy of species, and the diaries of minor expeditions.

Other papers of more general popular interest are printed in the Appendix to the Annual Report.

Papers intended for publication in the Proceedings and Bulletin of the National Museum are referred to the Advisory Committee on Publications, composed as follows: T. H. Bean (chairman), A. Howard Clark, R. E. Earll, Otis T. Mason, Leonhard Stejneger. Frederick W. True and Lester F. Ward.

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

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LIST OF CORRECTIONS.

Page 289, line 24, for *three* read *the*.
Page 289, line 25, for *six* read *the;* for *teqi'a* read *teru'a* at end of line.
Page 289, line 26, for *sighs or moans* read *disconnected notes*.
Page 339, line 33, for *Cephalopods 5* read *Cephalopods 3*.
Page 339, line 34, for *123* read *120*.
Page 359, line 7, for (*ante, page* —) read (*ante, page 356*).
Page 359, line 42, for *257* read *267*.
Page 369, line 45, for *cyclone* read *cyclones*; for *hurricane* read *hurricanes*.
Page 401, line 13, for *antiquatus* read *antiquata*.
Page 401, line 19, for *barbatus* read *barbata*.
Page 603, line 33, for *Denkhardt* read *Denhardt*.
Page 690, line 30, for *surmichrasti* read *sumichrasti*.

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

FOR THE YEAR 1893.

VOLUME XVI.

INTRODUCTION TO A MONOGRAPH OF THE NORTH AMERICAN BATS.*

BY

HARRISON ALLEN, M. D.

The bats constitute the order Cheiroptera. Unlike related groups which are equally extensive, the bats do not vary in sufficient degree to be confounded by any possibility with other creatures. By an untrained observer shrews might be mistaken for mice or voles, some of the smaller marsupials for minks or weasels, conies for marmots. But the popular impression of a bat is accurate, since this creature is the only mammal adapted for true flight, and no other mammal resembles it. If any mammals exist or have existed that are half bats and halt moles, half bats and half lemurs, half bats and half marmots, they are quite unknown to the naturalist. Paleontology is silent as to the origin of the bats, though comparison of their bony framework with those of the Insectivora, Lemuroidea, and Rodentia suggest that they may have arisen from the mammalian stem not far from the points at which the differentiation of these branches began.

MEMBRANES.

Let us examine the undissected bat, and endeavor to establish thereby general conceptions of the creature and of some of the signs of the superficies by which its varieties can be named. It is at once seen that the anterior extremities are furnished with greatly elongated fingers, the intervals between which are occupied by two layers of skin. Goldsmith uses a happy phrase when he says "the fingers serve like masts that keep the canvas of a sail spread and regulate its motions."

*The monograph from which this introduction has been extracted will be published as a Bulletin of the National Museum. The printing of the latter having been unavoidably delayed, it has been thought best to publish this introduction in advance.—F W T

Layers of skin thus make up the wing membrane. They are continuous from the last finger and the thumb, or some adjacent surface, to the sides of the body, the neck (both above and below the arm and forearm), and the outer side of the posterior extremity. Each wing membrane reaches below the knee and from this point, in varying degrees, to the ankle and the foot. The space between the posterior extremities is also occupied, as a rule, by two adjoined layers of integument which constitutes the interfemoral membrane. This structure as opposed to the above is less constant in form and dimensions. It may be guided by a long tail quite to its tip, it may allow the tip to project in different degrees beyond its free margin, it may greatly exceed in size that of the stunted tail, it may be defined as a hem along the inner border of the limbs, or it may be entirely absent.

It follows from these statements that all bats are provided with a back and a front skin-expanse from the sides of the body to the extremities in a constant manner, but from the tail to the posterior extremities in an inconstant manner, the last named presenting modifications determined by degrees of outgrowth of the tail itself.

The membranes present many details with respect to the manner of their attachment to the sides of the body and to the various parts of the limbs. Interesting variations of plan are seen where the skin crosses joints. In the elbow joint the skin may be attached entirely to the epicondyle, so that the joint lies quite to the under side of the wing, as in the African fox-bat, *Epomophorus;* or it may be attached midway, namely, to the olecranon, as in many forms, but perhaps best seen in the neotropical American *Saccopteryx;* or it may be attached entirely to the epitrochlea, so that the joint lies quite on the upper surface of the wing, as in *Rhinolophus pearsoni* and *Taphozous.* At the wrist distinctions are seen in the manner in which the tendons of the extensor carpi ulnaris and flexor carpi ulnaris are disposed at the angle which is formed between the radius and the fifth metacarpal bone. When this angle is marked, and skin folds are conspicuous over the tendons named, a radio-metacarpal pouch is defined. The knee always lies on the upper surface of the membrane. It is most free in *Macrotus* and least so in the Molossi.* The membrane attached to the ankle may lie entirely to the pollical side of the joint, but is disposed to cross it by an oblique raised fold and be secured to the minimal, *i. e.*, little toe side.

I have found it convenient to employ a number of names for the subdivisions of the dermal expanse.

The membrane which extends from the sides of the trunk to include the anterior extremity is the wing membrane ("bat wing," patagium).

The membrane between the legs is the interfemoral membrane (uropatagium).

* The group named the Molossi will be held in this essay to be distinct from the group of which *Emballonura* is the central genus. I am of the opinion that these alliances are distinct and co-equal.

The wing membrane above the arm and forearm is the prebrachium (antebrachial membrane, propatagium).

The wing membrane below the arm and forearm would become antithetically the postbrachium. But since the postbrachium could not be separated from the sides of the trunk and the legs, it has been found necessary to discard it.

The part of the wing membrane lying between the body, the humerus, the lower extremity, and a hypothetical line drawn downward from the elbow and intersecting the free margin of the membrane, is the endopatagium.

The boundary at the elbow is often fixed by the vertical terminal branch of the intercosto-humeral line. The subordinate lines (probably platysmal in origin) in the endopatagium incline obliquely either toward the humerus or the trunk.

The part of the wing membrane which is limited by the line at the elbow as above given, by the forearm, and the fifth metacarpal bone and phalanges, is the mesopatagium.* Within the mesopatagium the subordinate lines incline either toward the forearm or the manus.

The part of the wing membrane limited to the manus becomes the ectopatagium (dactylo-patagium). The subdivisions of the ectopatagium are the first, second, third, and fourth interspaces. These are named from the pollex toward the quintus. The series of bones which is embraced in the metacarpal and phalangeal lines being conspicuous in the bat, it is desirable to possess a name in referring to each series taken as a whole. The name digit will be used for the rod of segments embracing the metacarpal element. The nerve which appears at the anterior margin of a digit becomes predigital, and that of the posterior margin, postdigital.

The cartilaginous tip to the terminal bony phalanx, respectively, of the third, fourth, and fifth fingers will receive the name of the third phalanx when three phalanges are present, and of the fourth phalanx when four phalanges are present. The shapes of the terminal phalanges are of interest and some of these will be described.

I have examined a sufficient number of genera to suggest that an account of the markings of the wing membranes and of the shapes of the terminal phalanges enter into all discriminating studies.

The division of the wing membrane into the parts endopatagium, mesopatagium and ectoöpatagium is sustained by what is observed in *Taphozous mauritianus*, since in this species the endopatagium is of a dark color while the rest of the membrane is white, excepting the extreme tip of the end of the third finger. Now when the animal is at rest the surfaces above named are those only which are exposed to the light. In all young bats which cling to the mother, without exposing any other portions of the membrane than those named, it is evident that for a

*The endopatagium and mesopatagium are together the same as plagiopatagium of Kolenati. (Beitr. z. Naturgesch. der Europ. Chir., Dresden, 1857.)

long period the endopatagium has functions which are not exacted of the rest of the wing membrane, and in consequence, in my judgment, it is easy to see how this portion of the wing expanse should be distinguished from those portions which are used only in flight.

The digits on their palmar aspect may be sharply defined as in the Phyllostomidæ and *Corynorhinus*, or they may be obscured by the membrane or the upper part in the forepart of the hand, namely, in the region of the second, third, and fourth digits, as in Molossi, Vespertilionidæ and the genus *Antrozous*. The membrane may lie chiefly on the upper aspect of the digits, as in most bats, or at the lower. That in the second interspace may be attached to the upper border of the second and to the lower border of the third metacarpal bone.

The skin is much more loose about the legs than the arms and on the interfemoral membrane than the wing membrane. The membranes are attached to the lower border of the first two or three caudal vertebræ, thus permitting them to be seen distinctly *above*, and to the upper borders of the remaining vertebræ, thus permitting them to be seen more distinctly *below*.

The skin of the two sides of the body unite in such wise as to permit a very narrow interval to exist between the two layers. The upper layer of the wing membrane is extending directly outward on a level with the back of the chest and of the loin, but the lower layer is variable. It may extend outward as in the upper layer, but a disposition exists for it first to conform to the curve of the side of the trunk and join the upper layer near the union of the side with the upper surface of the trunk. In one remarkable instance, *Chilonycteris davyi*, the under layer extends quite to the middle line of the back, and thence is deflected in an acute angle outward to join the upper layer. The region of the axilla is greatly depressed in bats, owing to the inclination for the under skin layer to extend upward and backward. This space is so large as to suggest the adaptation of the pouch thus formed for the protection of the young. In *Cheiromeles* it must have another significance, since it here constitutes a huge bag-like involution which extends as far as the middle line of the back.

THE WING MEMBRANE AT REST.

The bat when at rest folds the fingers by a movement of the root of the hand (carpus) downward on the wrist end (distal end) of the forearm. This movement is characteristic and when completed brings the fingers in a compact bundle (like the ribs of a closed umbrella) under the forearm and parallel to it. The hand is thus tucked up toward the rest of the anterior extremity, and as the forearm (in the same movement) is sharply flexed on the arm the entire extremity presents the greatest possible contrast to what it exhibited when prepared for flight. The bat now supports the body in one of two ways. It is prone, *i. e.*, with the front of the body downward on the plane of support, or it is pendant, *i. e.*, hung by the claws of the hind feet. If it is prone the base of

the thumb and wrist supports the body and is furnished with a hardened pad of skin (callosity) for the purpose, the thumb being held at the same time well out of the way, and the posterior extremity taking the position nearly the same as that of terrestrial quadrupeds. The best example of those that scurry* when the wings are folded are the Molossi. In this group the phalanges of the third and fourth digits are now no longer held in axial line with the metacarpals as in flight, but are drawn upward and to the side, though well out of the way. The tail in all prone forms remains extended and the tip touches the plane on which the animal rests. If the bat is pendant in rest the base of the thumb and wrist do not support. The thumb is without callosity, is more engaged in the wing membrane, and is drawn more or less in toward the under surface of the wing. In this event the foot is furnished with sharper and more recurved claws, since they are now prehensile. The leg assumes a position quite at variance with the terrestrial position and is different in this regard from all mammals, the sloth alone excepted. The tail in the pendant form, at least in our red bat, is drawn well forward and rests on the lower part of the trunk. It is readily seen that very long digits of the anterior extremity would be more or less in the way in the prone forms, while they might be extended to any degree in the pendant forms, without interference.. In fact the first named have smaller digital elements than the last and the wing expanse is correspondingly more restricted.†

THE WING MEMBRANE IN FLIGHT.

While interesting characters are thus observed in the bat when at rest it is in the use of the limbs in flight that the chief peculiarities are noted. The intervals between the digits vary greatly in the different genera. As already remarked the under surfaces of the second and third digits are boldly outlined or are covered with membrane so as to obscure their outlines. In the forms in which this obscuring is noticed the fifth finger is supported by a little rod of cartilage.

The opening of the wing exerts a powerful influence over the posterior extremity. It pulls it outward in the forms in which an interfemoral membrane is present and thus makes tense this membrane. The entire limb is abducted from the terrestrial position and the foot is turned with its plantar surface forward.

*A word was needed to express the terrestrial motion of a bat whose wings are at rest. I venture to use "scurry" in lieu of a better.

†The contrast between prone and pendant positions of bats when at rest is an instructive one. It supposes the existence of a number of adaptive characters, which will be observed in the accounts of members of our fauna. So little is known of the habits of bats that it would be premature to base any generalizations upon these or any other isolated groups of structural peculiarities. I have seen our common brown bat in captivity hang itself up by the claws, but have never seen it other than prone when at rest in its native haunts. I am also aware that *Rhynchonycteris* (which has a flexed thumb and a small potlical callosity) comes to rest like a moth; *i. e.*, with wings expanded yet prone.

The wing membrane may be said to be redundant when the expanse above the arm and forearm extends freely to the carpus and embraces the small thumb to a point beyond the first phalanx of the thumb; when it extends down to the foot beyond an oblique muscle line which extends upward and outward from the lower part of the leg; when the space between the second and third digits is ample, and that between the thumb and second digit is provided with a well-defined hem of membrane.

Skin folds are often disposed along the lines represented by the palmar fascia, at the proximal end of the fifth digit.* The flexor tendons at the radio digital angle are often covered with similar dispositions of the skin.

The membranes are supported not only by the parts of the skelatal frame-work, as these parts are usually defined, but by a number of special adaptations. An accessory cartilage at the somad margin of the terminal fifth digit has been already named (Molossi and Vespertilionidæ, except Plecoti). The interfemoral membrane is supported at the free margin by a special cartilage (calcar) from the tarsus in all bats excepting the Pteropi, Rhinolophidæ, and the Stenodermidæ. The calcar may have a process from its under margin, as in *Noctulinia noctula*. The terminal joint of the tail may be spatulate, as in *Nycteris*. Terminal cartilages of the third and fourth digits are present except in Pteropidæ, Rhinolophidæ, and Emballonuridæ. They are of varying shapes, the whole arrangement having for its object the support of the free margin of the wing membrane. These cartilages, as a rule, are deflected outward, though they may remain axial, as in Phyllostomidæ and Plecoti.

All things remaining the same, the degree of strain may be measured by the extent and variety of these special supports, and may be said to be in the line of specialization for aerial movements. Hence, in forms in which they are absent the membranes are broad and may be said to exhibit more of a parachute arrangement than in other types in which they are present, and the motion of the wings to be like that of a slow fanning rather than a rapid, varied flight.

Strain on the membranes is also shown in the angle form between the portions of the wing farthest away from the body, namely, the region of the second and third digits. These are pulled away from the fourth and fifth digits, which remain nearly passive by the traction of the muscles which extend these bones (extensores carpi radiales longior et brevior), and the whole membrane becomes tense. The contrast between the shapes of the wing in this regard is considerable when such forms as *Artibeus*, *Nyctinomus*, and *Atalapha* are compared.

When the wing of a bat is held up between the eye of the observer and a bright light the membrane is seen to be translucent. The delicate connective tissue lines (trabeculæ) are seen uniting the various

* Vespertilionidæ (excepting Plecoti) and Molossi.

parts of the bony framework, and the positions of the nerves, blood vessels, and muscle-fascicles are displayed. The paths of the nerves and blood vessels constitute one system and may be spoken of together, but the traceulæ and muscles are distinct from these and in some degree from each other. As in the case of the relation which exists between the skin and the bones, so in the arrangement of the parts just named the degrees of strain to which the wing is subjected account in the main for the difference in the various genera. The muscle-fascicles are most numerous in the membrane near the body, and are better developed in the narrow-pointed winged forms, such as Molossi and *Atalapha*, than in the broad, parachute-like forms. The muscle element in the wing is especially weak in the Pteropidæ, Rhinolophidæ, and Vespertilionidæ.

The fibrous lines which extend across the membranes are not without system. Many of them are excessively attenuated tendons; such, for example, are the fibres of the palmar fascia, already mentioned. Others are the fibres which connect the joints of digits; more of them yet appear to be parts of a true derm. The nerves and blood vessels pursue the same courses. Since the directions of nerves are of more importance in morphological study than the vessels, the former will be alone named. In each interdigital space a nerve tends to enter at its proximal end and, dividing into two branches, incline along the sides of the opposed metacarpal bones. The departures from this plan are numerous, and are so constant in groups of generic and even specific limitation that they constitute a valuable addition to diagnoses.

The wing membrane, when expanded, exhibits differences in the width of the interdigital spaces. These differences relate in an intimate manner with the behavior of the parts in flight, and consequently with habit. The subjoined table indicates some of these distinctions:

Manal (pteral) formulæ of the widths of second, third, and fourth interspaces.

Species.	II.	III.	IV.	Fore-arm.	Difference between III and IV.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Lophostoma	7	17	18	49	1
Schizostoma	3	16	21	32	5
Macrotus	2	15	22	44	7
Desmodus	2	21	37	53	10
Vampyrops	3	17	27	36	10
Chilonycteris	1½	15	17	40	12
Hemiderma	5	20	32	26	9–12
Vampyrus	16	41	53	105	12
Lonchoglossa	3	19	32	33	12
Monophyllus	3	17	34	32	14
Artibeus	4	21	39	51	18
Brachyphylla	3	25	43	64	18
Mormops	3	16	35	50	19
Phyllostoma	4	29	62	81	45
Rhynchonycteris	5	16	25	40	9
Cynopterus *	10	18	27	58	9
Vespertilio †	2	11	31	59	10
Epomophorus ‡	13	21	30	83	11
Rhinopoma	3	13	30	64	17
Molossus §	½	5	35	46	30
Noctilio	2	13	58	83	45
Pteropus ‖	18	17	69	145	52

* C. marginatus.
† V. murinus.
‡ E. franqueti.
§ M. rufus.
‖ P. edwardsii.

This list is selected in the main for comparison in members of a single family, viz, the Phyllostomidæ. The last eight forms are from families other than the one first named.

It is believed that these distinctions may be conveniently included in the characteristic proportions of bats.

In flight the thumb is extended in Vespertilionidæ, but partially flexed in Phyllostomidæ (excepting *Desmodus* and *Diphylla*) and in *Plecoti*. The degree of inclosure of the thumb in the membrane answers to the amplitude of the membranes generally and when extensive tends to draw the thumb slightly toward the palm, the space between the thumb and index finger being moderately occupied by a skin expansion.

It is a tendency under certain conditions for all growth processes to dominate functions other than those which are essential to their own activities. The best general conception of the manner of extending a fold of skin between the limbs is seen in the Batrachia. In the water newts a longitudinal ridge is often seen extending along the sides of the trunk. This is continuous along the hinder border of the anterior extremity (well developed in *Menopoma*) and reaches as far as the tip of the fifth digit. This fold is supplied by the ulnar nerve, which appears to be in its earliest expression a nerve for the skin of the posterior border of the forearm, of the fifth digit, and the muscles found in these regions. The phenomena of a fold of skin extending between the toes is one already familiar, so that the general plan of the skin expanse in a creature so low as the *Menopoma* prefigures that of so highly specialized a form as the bat without violence and without leaving a single line obscured. Difference of degree and not of kind separates them.

The very exceptional disposition in the bat for the skin from the trunk to extend the entire lengths of the limb, and in the case of the anterior extremity to form enormous webs between the produced digits, is associated with an inclination for the ears to become greatly expanded and for cutaneous offshoots to appear at the muzzle, chin, and the sides of the face. Even the prepuce is disposed to be redundant. Together with this inclination, dermal structures are highly specialized, so that the sebaceous glands, hair follicles, and tactile bodies are well developed. It can be readily surmised that special adaptations for a variety of purposes occur in this group of structures, so that secondary sexual characters are found in the gland masses of the skin of the neck, and of the skin folds, the details in the ears, the pouches of skin, etc., are available for purposes of classification.

THE EXTERNAL EAR.

In this connection let us glance at the peculiarities of the external ear. The external ear is markedly modified from the type usual in quadrupeds. Its simplest expression is seen in the Pteropidæ and the Rhinolophidæ. In these families the widely separated auricular carti-

lages are closely enwrapped by integument and the tragus is absent. In such an ear the terms *inner* and *outer borders* and *tip*, exhaust the list which are demanded in their description. In the ears of the remaining families it is far different. The auricle here is expanded to degrees which bring the outer parts to a greater or less degree downward and forward on the upper parts of the neck and reach the region of the mouth, or even the chin, while the inner border, being guarded by a skin fold which connects the ear to the crown, is disposed to be united with the corresponding part of the ear of the opposite side and extend in varying degrees toward the snout. Skin lap pets arise from both inner and outer borders. Those from the inner border from a long appendage which lies in advance as defined in the simple ear and becomes the *internal hem*. As a rule it ends as a free lobe inferiorly, which thus becomes the *internal basal lobe*. The line of the true internal border being always discernible becomes the *internal ridge*. The external border, which is distinguished from the true external border which now becomes the external ridge is also disposed to form a hem (*external hem*), which, however, in contrast to the inner is apt to be divided into an upper and a lower part; the upper part forms the *first scallop*, and the lower the *second scallop*. The free lower end of the outer border becomes the *external basal lobe*, which may be separated from the lower scallop by a deep *basal notch*, or the second scallop may extend across this notch and the external basal lobe and becomes continuous at various distances with the face or that over the lower jaw. These parts will not receive distinctive names. In most examples the auricle is also conveniently divided into an anterior and a posterior part, the anterior part is marked, if marked at all, by lines repeating that of the internal border, while the posterior part is marked, if marked at all, by conspicuous transverse lines or striæ. The hair when it extends upward on the ear from the crown is usually of the color and character of that of the crown, while that of the posterior is of the color and character of that of the neck.

The *tragus* varies exceedingly in form. The following terms are employed in its description, viz, the *inner* and *outer border*, the *tip*, the *notch*, which is near the base of the outer border, and the *basal lobe*, which lies below the notch. The tragus is said to be absent in Pteropidæ and Rhinolophidæ, but in some examples of the family last named a rudimental tragus can be discerned. The tragus always arises from the ridge which lies in front of the auditory meatus and connects the inner and outer auricular borders. It is of interest to observe that while this connection with the borders is imperfectly defined in most bats that in the recently discovered *Euderma* it is markedly so united and tends to constrict the basal parts of the enormous auricle.

Not only is this the case, but the ears are often united by a band (*inter auricular membrane*) which extends obliquely forward. In *Corynorhinus* and *Macrotus* it is on the face, and in *Promops perotis* reaches quite to the snout.

In illustration of the value of the ear in classification the following table is drawn up from the members of the bats described in this memoir.

Phyllostomidæ.—External ear without internal basal lobe. External ridge rudimental or absent. External basal lobe not marginal, but lies well within the large second scallop, which is continued well in front; tragus prorect, coarsely crenulate or spinose on outer border.

Molossi.—Ears without internal basal lobe. Internal ridge produced forming a "keel." External ridge marginal, produced, bounding external basal lobe. External basal notch open, *i. e.*, not covered by lower scallop; tragus rudimental.

Vespertilionidæ.—Ears with internal basal lobe. Internal and external ridges rudimental, not produced. External basal lobe marginal (except Plecoti), not touching external basal ridge. External basal notch occupied by produced lower scallop. Tragus obscurely crenulate on outer border, or smooth.

SECONDARY SKIN DEVELOPMENTS.

At the muzzle the skin folds are median and lateral. The margins of the nostrils expand above and at the outer side while they are separated by a groove or a ridge in the middle line, as is seen in *Brachyphylla* and *Nyctinomus*. Or the two lines of perinarial expansion may meet below in the space between the nostrils and the lip to form a swollen ridge as in *Glossophaga* or a lappet as in most *Vampyri*, while the internarial ridge is continuous with a vertical leaflet. This is the type seen in most of the Phyllostomidæ as exemplified in this memoir in *Artibeus* and *Macrotus*. The nostrils may remain simple with upper border advanced upon lumen of the opening so as to divide it into two cornua as in most Vespertilionidæ or the lumen may be oval as in *Euderma*

The lower lip is firmly held to the gum of the lower incisor teeth, as in Vespertilio, or it is free and forms a protrusile, membranous fold as in *Atalapha*. It may be entire or divided in the center so as to form two chin plates as in *Macrotus* and as a variation in *Nycticejus*. In *Atalapha* a distinct lappet extends entirely across the chin and in degrees of development distinguishes the sexes. The chin itself and the space directly back of it is adorned with scattered warts in all forms, but in *Phyllostomidæ*, as shown in *Artibeus*, the entire chin is conspicuously adorned with verrucæ arranged in median and lateral groups. In *Chilonycteris* and *Mormops* these are the sites of curiously complex leaflets.

The sides of the face are furnished with skin-folds of various lengths, which are continuous with the external border of the auricle, or a large wart lies directly back of or below the angle of the mouth, while the sides of the muzzle are apt to be more or less thickened by swollen gland-masses, which tend to embrace the side of the nose-leaf as in

Artibeus and *Macrotus*, or ascend toward the vertex of the face, where they either approach each other on the top of the muzzle as in *Antrozous*, or end free as in *Corynorhinus*.

HAIR.

The hair of the body is arranged in regions having well-defined boundaries. The crown of the head, the region directly in front of the ear, the neck, especially the side and back, inclusive of a line across the top of the chest, the shoulder itself, the sides of the under surface of the body, the rump, and pubis are all regions which are often separately colored, or clothed with hair of distinct texture, or rate of development than that of the other portions of the body. The sides of the neck are always furnished with longer hair than is the front and ordinarily than is the back. The hair of the pubis is more woolly than that seen elsewhere. The hair extends farther on the dorsum of the face in *Vespertilio* than in most genera. The same region is naked in *Adelonycteris*. The shoulders are occasionally furnished with shades of color contrasting with that of the rest of the body.

The membranes are clothed with hair in varying degrees. The greater area is naked. The interfemoral membrane is more thickly clothed on the upper than the lower surface, a tendency reaching its maximum in *Atalapha*, while the lower surface of the wing membrane between the body and the border of the manus—a tendency also marked in *Atalapha*, but most marked in the Asiatic form of the noctule bat (*Noctulina noctula lasiopterus*). As a rule the fur from the under surface of the body extends from the upper third or half of the arm to the knee. The presence of a clump of hair on the dorsum of the forearm is a good peripheral character for *Atalapha cinerea*. The interfemoral membrane as a rule is covered with an extension of hair from the rump to the basal third in most Vespertilionidæ. In *Vespertilio* an interesting character is noted in this clump, not being well defined, but straggles downward in an irregular manner and is lost near the ankle. This disposition is especially developed in *Vespertilio capaccini* and in the Nevadan variety of *Vespertilio nitidus ciliolabrum*. The lower border of the membrane is constantly fringed in some forms of *Vespertilio*, but as an individual variation in the North American species. It is rare to have the lower border of the wing membrane from the foot to the manus fringed as in *Pteropus*, but *Vespertilio*, as seen in North America exhibits a singularly constant, minute bristle which overlies the membrane at the tip of the fifth finger. The ears are apt to be sparsely haired on the inner surface near the anterior border, on the outer surface at the basal third or half, and on the external basal lobe. On the whole the bats which take the prone position in rest are less heavily furred than those which are pendent. In one of the most marked forms of the former group (*Cheiromeles*) the skin is nearly naked. Interesting contrasts can be made in this way between the haunters of

caves, attics, and old tree trunks and those which are caught hanging from the smaller branches and twigs of trees and bushes.

Bristles (setæ) usually surmount warts (verrucæ). They are best developed on the face of *Molossi*, though they may be found in the group last named on the upper surface of the interfemoral membrane. The very long hairs of the sides of the muzzle, which are so conspicuous in many of the small mammals of other orders, notably the Rodentia and Carnivora are absent. The best examples are met with in *Vespertilio* and *Choeronycteris.* Fringes of bristles adorn the margins of the toes in Molossi.

In describing bats in this manner the attention which has been given to the details of the coloring and the markings on membranes require an exact use of terms.

When hair arises from the membrane it will be seen that the clumps follow the directions of the trabeculæ and are detected in the translucent wing as minute black dots arranged in rows. These must not be confounded with pigment spots which dot the naked spaces of the wing in some species.

GLANDS.

The skin glands are best developed on the sides of the face directly back of the muzzle. In Molossi a large, median, coarse sebaceous gland lies on the under surface of the neck. It is best developed in the male. The mammæ are large during the lactating period when the nipples are projecting and the aveolar space naked. At other times the nipple disappears and the gland is reduced to the smallest possible proportions. In *Saccopteryx* and its allies the wing membrane above the anterior extremity is furnished with a sack which is lined with folds which yield a fetid secretion. The position and size of this sack furnish excellent characters to distinguish genera as well as sexes of individuals.

COLORATION.

It is necessary to state that the colors for the most part are described from alcoholic specimens which have been removed from the spirit and permitted to dry. Mr. F. W. True writes in the Smithsonian Report for 1888 that alcohol disturbs the color scheme of a mammal. The character of alcohol is not especially here named and the remark is undoubtedly correct for specimens which have been preserved in wood spirit. However, none of the specimens used for study have been preserved in other than commercial alcohol which has been variously diluted with water. I have observed no differences of the kind named between the few living individuals I have seen, the fur of the dried skin prepared in the usual way with arsenic and in skins dried after prolonged immersion in commercial spirit. It must also be remembered that since all the material available for my study has been preserved

in the same medium the comparisons are sufficiently exact for purposes of identification of museum alcoholics. It is barely possible that the color description may require some modification as contrasted with these drawn up from living specimens.

SKELETON.

Skull.—In describing the skull in bats, I have borne in mind that the form of the brain gives expression to the shape of the brain-case to a far greater degree than is the case in other mammals. The divisions of the brain are readily outlined externally, and yield convenient boundaries, since the shapes of associated parts harmonize in some degree to them. Thus the region of the proëncephalon, of the mesencephalon, and of the metencephalon are defined. In like manner the impressions made by the lines of attachment of the temporal and masseter muscles, the former on the cranium, the latter on the lower jaw, are valuable. For the temporal muscles I have named the median line between the two the sagittal crest or line, and the anterior and posterior temporal impressions the anterior and posterior temporal ridges or lines.

On the under surface of the skull the size and direction of the process (sphenoidal tongue) which extends backward and outward from the basisphenoid is worthy of notice. As compared to other mammals, the cochlea is unusually large at the base of the skull, and is, as a rule, but partially concealed by the tympanic bone.

The otic capsule varies in the degree in which bony laminæ occupy the spaces created by the semicircular canals. On the side of the skull the surface (opisthotic) which adjoins the squama in mammals generally is in bats crossed by a process of the squama uniting with one from the exoccipital, as in *Atalapha*, or the surface is free as in *Nyctinomus*. The old-world genus *Hipposideros* resembles *Nyctinomus* in this particular. When the otic capsule falls out, as it is apt to do in the overmacerated skull, a foramen or a notch is always defined between the squama and the occipital bone. Sometimes a foramen of the same significance, viz, one occupied by the opisthotic during life, is seen on the occiput.

The otic capsule in Pteropidæ alone is inclosed in bone, to form a triangular wedge comparable to the *os petrosa* of other mammals. As a rule, the form of the cochlea and semicircular canals are outlined as though in the human skull the encapsuling petrosal bone had been chiseled away, the degrees in which thin plates of bone fill in the semicircular canals being alone subject to change. The horizontal loop in all forms examined is filled with bone.

The following scheme of the otic element will be found useful:

External loop entirely occupied with bone:

Superior loop angulated, open............*Artibeus*.
Superior loop nearly filled...............*Nyctinomus* (*N. brasiliensis*).
Superior loop about half filled............*Atalapha*.

External loop almost entirely occupied with bone:

Antrozous.
Vespertilio.
Adelonycteris (*A. fuscus*).

External loop and superior loops not occupied with bone:

Noctilio.
Macrotus (occasionally excepted).
Hemiderma.
Chilonycteris.

The tympanic bone is sometimes incomplete, as in *Vespertilio*, at its upper arc, where it limits the zona tympanica superiorly. The bone constitutes the bulla, which presents various degrees of extension over the cochlea or forward along the side of the glenoid fossa. The width of the origin of the sterno-mastoid muscle is much greater than in mammalia generally. This interval in *Artibeus* equals one-seventh of the greatest length of the skull, which in *Canis* it equals one-nineteenth.

Seen from above, the face is described as forming a vertex. This extends from the region of the proencephalon to the upper border of the anterior nasal aperture. On the side the region of the face is equal to the length of the dental series. The orbit is, strictly speaking, that portion of the skull which accommodates the eyeball; but this is much smaller than the space as defined by the bony limits, as seen in many other mammals. Since custom has sanctioned an acceptance of an orbital region which would be limited posteriorly if a process were present extending from the anterior temporal ridge toward the zygoma, a similar region so restricted is held to be a valid one in all bats. In some genera, indeed, as those of the Emballonuridæ, the post-orbital process is constantly present, and in the Pteropidæ varying degrees of posterior limitations of the orbital region are seen. The face, including a part of the frontal bone, is inflated at the side in bats. I have called this the fronto-maxillary inflation. It forms a ridge or swelling at the upper border of the orbit. The inflation of the skull at the anterior part of the frontal bone to form the frontal sinus is much less conspicuous in the Cheiroptera than in some other orders, but the maxillary inflation is greater. This peculiarity gives the face a broad effect at its junction with the brain-case and modifies the shape of the orbit. The ethmoidal plates variously change the shape of the inner wall. As a rule, the frontal bone here permits the ectoturbinal parts to be in part defined. The region of the lachrymal bone appears to resist the disposition to inflation; hence the peculiarities of the inflation give character to this portion of the cranium. On the vertex the inflation causes the face to widen from the proencephalon to near the anterior nasal aperture, where it is abruptly narrowed, and to create depressions of inconstant kinds in the line of the conjoined nasal bones. The extent to which the recession of the nasal bone from the anterior nasal aperture occurs, as well as of the palatal notch, due to the rudimentary state of

the premaxillæ, afford bases for some characters of minor value. The length of the infra-orbital canal and the peculiarities of the outer wall of the canal are of interest. In *Artibeus* the canal is long and for the most part smooth externally, as in *Canis*, while in the fauna generally it is short, as in *Felis*, and is often elevated.

The hard palate may be either in the main axis of the skull, as in most forms, or deflected upward and forward. The characters furnished by the pterygoid processes, the palatal plates, are here as useful as in other mammalian groups. The premaxillæ are rarely firmly united to one another. When they are so united, as in Phyllostomidæ and Molossi, the median incisors are disposed to be contiguous. When they are not united, a large median interspace separates them and is continuous with the vacuity which in other mammals represent the incisorial foramen. The presence or absence of the spheno-palatine foramen is used in some groups, as Molossi and in Plecoti, in separating genera. The disposition of the turbinals is also of interest, the peculiarities of the arrangement being definitive of the families as established on other structural characters. If in mammals generally an outer and an inner turbinal group is recognized, then in the bats we have a median lamina which bears upon its inner surface one or more scrolls (endoturbinals), and an outer lamina with much simpler accessories (ectoturbinals). The simplest arrangement of the turbinals is seen in the Nycteridæ and Rhinolophidæ, the most complex in Pteropidæ. In *Natalus* alone is the ectoturbinal rudimental or absent. (Bull. Mus. Comp. Zool., Feb., 1880.)

In addition to the peculiarities of the masseteric impression on the lower jaw, already noticed, characters are furnished in the height of the coronoid process and the degree of deflection as well as the size and shape of the angle. The post-symphysal spine which is conspicuous in some extinct forms has not been seen by me in any of the extant forms, and I have examined most of the genera of the order.

The shortening of the face, *pari passu*, with reduction of teeth, is seen in Carnivora. The tendency is seen in *Vesperugo*, and in bats generally. In *Vespertilio* the shortening of face is accompanied by displacement inward of the premolars. In a mechanical sense it amounts to the same as reduction in number. In pteropine bats a remarkable persistence of facial length remains, while the disposition to reduction is evident. One may conclude from the instance last named that the shortening of face and reduction of teeth are independent. The same is true of the Ungulata.

In *Atalapha* the lower jaw closes in front of the upper. The lower canines articulate with the anterior surfaces of the upper laterals their entire length. The upper canines are free, *i. e.*, do not articulate with anything.

Vertebral column.—The vertebral column is without large processes other than the hæmopophyses which are well developed in the cervical region.

The atlas is broadest in Pteropidæ. In both *Pteropus* and *Epomophorus* the bone extends downward posteriorly and at the sides so as to conceal the lower opening of the canal for the vertebral canal. The upper border of the conjoined laminæ is boldly rugose. In *Artibeus*, a member of a group in the New World analogous to the foregoing, the atlas is greatly reduced in the proportions of the laminæ and the transverse process, the lower opening of the canal for the vertebral canal is exposed on the posterior aspect of the bone, while the upper border of the conjoined laminæ is scarcely rugose. In the vespertilionines, molossines, and phyllostomines minor peculiarities distinguish the atlas. These are given in the diagnosis of genera and species. In a general way it may be said that the pteropines are broadly separated from all the other bats by the characters presented by this bone. In *Pteropus* and *Epomophorus* the axis possesses a large neural spine which almost equals the length of the body inclusive of the cylindroid odontoid process. In Artibeus the spine is but one-half the length of the body inclusive of the tubercle-like odontoid process. The remaining portion of the cervical is curved more or less antero-posteriorly. This is less marked in the pteropine and phyllostomine genera than in the vespertilionine where the curve is so great as to bring the occiput almost to the first dorsal vertebra. The sacrum, at its upper portion, exhibits a compressed projecting ventral surface. The spinous processes are flat, distinct, and increase in size from above downward in molossines and *Atalapha*, but they are low and confluent in many forms as in the pteropines. The first coccygeal vertebra in tailed forms is large and resembles those of the sacrum. The caudal vertebræ below this are cylindroid. They vary greatly in length, especially at the beginning of the series.

Ribs.—The ribs are flat, broad, with wide intercostal spaces (coalescent in *Natalus* and *Hipposideros* for the region of the first and second ribs). The other interspaces are also well defined in Pteropidæ, but as a rule they are narrow, and in *Natalus* and *Hipposideros* are practically obliterated. The costal cartilages are relatively inelastic and are disposed to become early calcified. Indeed, the entire chest is rigid, and the ribs often become anchylosed to the spine, and in some forms, as in old individuals of *Vespertilio murinus*, the contiguous ribs to each other. Hence the respiratory movements are for the most part performed by the diaphragm and the flank muscles.

Sternum.—The sternum possesses a massive, broad prosternum and a narrowed mesosternum and metasternum. The prosternum sends a conspicuous process forward into the neck (as in many terrestrial mammals) in molossines; all the others are without this process. The first joint is usually conspicuously keeled, and in Pteropidæ this keel is divided by a deep notch. The mesosternum in the same family is also keeled its entire length, but in the other groups it is barely ridged or smooth.

Anterior limbs.—The *clavicle* is present in all bats. It is firmly attached at both the acromial and the sternal end. The last named

effects an important articulation with the cartilage of the first rib and in the sterno-claviculo-costal joint; in Molossi, at least, it is of enormous strength. The *scapula*, as in other claviculate forms, with few exceptions, in which the large anterior extremity is not supported on the ground, possesses an infraspinatus fossa very much larger than the supraspinatus. The bone lies well up on the side of the neck in the forms in which the cervical series of vertebræ is bent forward. Excellent characters are yielded by the coracoid process. It is always long and slender, simple, and gently curved in various arcs in Pteropidæ, Rhinolophidæ, Emballonuridæ, and Phyllostomidæ, but bifid in most Vespertilionidæ. It is interesting to find the genus *Vespertilio* aberrant in this respect, the process being simple and curved quite as in the larger groups first named. The posterior tubercle is prolonged to form an oblique posteriorly-directed process in the molossines and in *Chalinolobus*.

With the exception of the tuberosities of the *humerus* no check processes exist anywhere in the bones of the limbs, thus presenting marked contrasts with the limbs of birds. The trochlear end of the humerus yields in the shape and direction of the epitrochlea valuable characters. This process conforms to the terrestrial type, *i. e.*, it is transversely inclined in pteropines and the genus *Saccopteryx;* is deflected downward parallel or nearly so to the shaft in phyllostomines, but is absent in vespertilionines. In vespertilionines again the articular surface is axial, *i. e.*, is in the middle line of the humerus, but in phyllostomines it is thrown well off to the outer side. Narrow-winged forms, as the molossines and the genus *Atalapha*, exhibit large tubercles on the humerus and wide trochlear surfaces. Thus these characters harmonize with rapid flight. On the other hand, the forms with smaller tubercles and narrow poorly defined trochlear surfaces have broad wings and presumably slow flight.

The *radius* constitutes the main support of the forearm and presents few variations from a single type. As a rule it is nearly straight, but is much bent in *Hipposideros*. It is always obliquely grooved by the tendon of the extensor ossi metacarpi pollicis. The size of the large deep fossa for the insertion of the biceps flexor is variable. Since the ulna does not enter into the composition of the anterior arc of the trochlea, and its place is here taken by the radius in addition to the work this bone does in articulating with the humerus at its outer half, it is easily seen that the radius is provided with two facets at its proximal end, and that the main ridge on the distal articular surface of the humerus fits in between these two radial facets. So far as the degree of invasion of the radius into the trochlea has been noted it appears to correlate with the degree of activity of the prone form in scurrying. It is thus marked in *Cheiromeles* and *Molossus*, and is small in *Kerivoula*.

The *ulna* is more inconstant in form than the radius; in all it is incomplete and is composed of a proximal and a distal rudiment. The proximal rudiment is free at the weak olecranon, which resembles the parts in the sloth, and is continuous in most genera with an arched rod-like shaft of uniform width, which is ossified, as a rule, with the radius at about its proximal third. Exceptions are noted to this arrangement in some of the vespertilionine genera, *e. g.*, *Scotophilus* and *Miniopterus*, as well as in the molossine *Promops*, in which a small anchylosed olecranon unites by a filiform shaft to the proximal third of the ulna. But the vespertilionine forms as a rule (*Harpiocephalus* not examined) retain a free olecranon which is continuous with a filiform tapering shaft, which ends free in the muscles of the forearm. *Corynorhinus*, *Nyctophilus*, *Chalinolobus* are exceptions even to this arrangement, for here the shaft is entirely absent, the rudimental fixed olecranon constituting the entire proximal end. The tendon of the triceps muscle as it is inserted into the ulna is occupied by a sesamoid bone. No other animals possess a bone in this situation. It is either a separate ossicle developed in the tendon, or the disjuncted epiphysis of the ulna. This relatively unimportant bone receives the muscle which alone extends the powerful forearm. The extensor carpi ulnar is—a muscle as constant in this group as in others—arises from it. All the relations of the ulna, therefore, are with the extensors. The distal end is anchylosed to the radius at the wrist. The form may be that of a quadrate plate which is usually entire, though it may retain a minute foramen of insufficiency, as a rule, in the vespertilionines. The plate may be absent when a hook-like process directed proximally, as in molossines and *Atalapha;* it may project nearly at right angles to shaft and be conoidal, as in phyllostomines, rhinolophines, and the genera *Saccopteryx* and *Natalus*; or it may be absent, as in the pteropines.

The carpus of bats exhibits some valuable characters. In all forms the first row of bones is composed of two bones only—viz, a large bone which constitutes the greater part of the row and will here receive the name of the scapho-lunar, and a small separate bone at the ulna border of the scapho-lunar which appears to be the cuneiform.

The second row is composed of the trapezium, trapezoid, os magnum, unciform, and pisiform. The os magnum and unciform always unite to form a convex surface for articulation with the second row. With the exception of the pisaform all these integers are easily recognized. The carpus on the whole is simple, since the first, second, and third metacarpal bones are in axial articulation with trapezium, trapezoid, and os magnum, respectively, while the fourth and fifth metacarpal bones articulate with the unciform.

In pteropines the trapezium and os magnum are greatly larger than are the other bones of the second row, and give a peculiarly massive appearance to the carpus when the wing is folded. The bone first named is without nodosity on the palmar aspect. Wedged between

the two bones last named is the insignificant trapezoid. Owing to the abruptly curved line formed by the heads of the metacarpals the second and fifth bones lie at the level of the plane, which would unite the ends of the curve, while the third and fourth form the bottom. The cavity defined by the curve as indicated is almost entirely occupied by a large hatchet-shape prolongation of the os magnum. Thus the os magnum, beside its axial attachments, is held on the one side to the second and on the other to the fifth metacarpal bone. The heads of these bones are so disposed as not to approach each other. The pisiform is absent unless it is represented in the palmar prolongation of the os magnum.

In rhinolophines the plan is that of pteropines. Though the bones are less massive than in that group, the methods of articulation are the same, and the pisiform is also apparently absent.

In *Artibeus* the palmar part of the os magnum articulates with a separate but much smaller element, which occupies the place of the hatchet-shape plate in *Pteropus*. The heads of the metacarpals are scarcely curved, and those of the second and fifth are disposed not to approach each other.

Among the vespertilionines we notice the following: *Corynorhinus* closely resembles *Artibeus*. In *Adelonycteris* the trapezium possesses a tubercle on the palmar aspect; the os magnum is without palmar plate either united or separate. The heads of the second and fifth metacarpals approach each other and almost touch. In *Atalapha* the tubercle to the trapezium is retained, while the palmar extension of the os magnum is absent. Articulating on the pollical side of the fifth metacarpal bone is a separate ossicle, which appears to take the place of the part last named. It is elongated and much larger than any of the carpal elements. I have named it the pisiform. *Antrozous* is much the same as *Atalapha;* the ossicle by the side of the fifth metacarpal bone is triangular in shape. The plate of bone which is continuous with the os magnum on its palmar aspect in pteropines appears to be the same as the separate ossicle in the same situation in *Artibeus*.

The bone which articulates by its base with the fifth metacarpal bone in *Atalapha* and *Antrozous* would appear to be identical with the above plate, since when it is present the os magnum ends in a simple manner toward the palm. It would appear to be the pisiform, since in *Atalapha* it was observed to receive the tendon of the extensor carpi ulnaris.

Sesamoid bones.—The sesamoid bones are found in locations where great motion is permitted on the side opposite to which the bones are lodged—the purpose being apparently to prevent stretching of the muscles which carry the sesamoids. At the point at which stretching would begin the bones lock with the joint surface and takes the strain. They are best developed on the dorsum of the carpus in phyllostomines.

The tendency above noted for the second and fifth metacarpal bones to incline toward one another on the palmar aspect of the carpus, and

as a result for the second bone to lie in front of the third and for the fifth to lie in front of the fourth, is a notable feature in the manus of. the bat. Minor differences are seen in the relative lengths of the bones. They are shortest in pteropines and rhinolophines. The second metacarpal is usually slightly shorter than the others, but in Hipposideros it is much shorter. The fifth metacarpal bone is apt to be the largest, as in *Pteropus*, but in *Hipposideros* and in the molossines it is the shortest. In the group last named and the related genus *Atalapha* the bones are marked by grooves for the powerful metacarpo-phalangeal flexors. The third metacarpal bone is commonly the largest, the fifth the shortest, the fourth being intermediate, yet in North American species of *Vespertilio* the fourth bone, being slightly shorter than the fifth, is sometimes an individual variation. *Megaderma* is remarkable for having the above order reversed—the fifth metacarpal is the largest and the third is the shortest. Viewed as a whole the manus, notwithstanding its enormous longitudinal development in the third, fourth, and fifth elements, is singularly unimportant in the first and second. The second, however, while unsupported by elongated phalanges, has strong architectural functions at the line of its union with the carpus.

The phalanges present few points of contrast. They are uniformly elongated rods. As a rule the second digit possesses a single rudimentary phalanx which may be free or semianchylised to the metacarpus. The highest degree of development is attained in the pteropines and in the genus *Rhinopoma*, the former having three and the latter two phalanges. In the pteropines the third is ordinarily furnished with a claw. They vary greatly in the range of motion, those of the second and fifth digits being the least mobile; in their relative lengths in the pteropines and the genera *Noctilio* and *Miniopterus*, these forms being remarkable for the degrees present of lateral and dorsal flexion. It has been noted on p. —— that the disposition and relative sizes of the phalanges vary in the scurrying and pendant forms. In the position of flight the row of first phalanges is flexed downward, but the row of second phalanges is at the same time deflected laterally; *i. e.* toward the body. In the position of rest the parts either remain axially disposed or the row of the first phalanges is laterally or dorsally flexed, as in the molossines and emballanourines. The terminal cartilages are apparently absent in pteropines and rhinolophines. When present they remain in axial line with the phalanges, as in phyllostomines (excepting *Vampyrus*), or they are deflected from that line, as in vespertilionines and molossines. These little rods appear to be indices of the amount and direction of strain to which the membranes are subjected, and point, therefore, to distinctions in methods of flight. It may be said that they are absent, or, if present, axially disposed in the broad-winged forms, but are deflected in the narrow winged. In vespertilionines and molossines (excepting *Kerivoula* (?) and *Antrozous*) the fifth digit is provided with an accessory cartilage, which lies to the outer side of the

terminal cartilage. It slightly projects from the margin of the wing membrane.

The much greater length of the third digit, as compared with that of other digits, is a noteworthy feature of the bat wing. Its relative length in different forms serves as a guide to generic and sometimes to specific distinctions.

The peculiarities of the thumb are so marked that they can be best considered apart from the other manal parts. The thumb, as a rule, is free from membrane beyond the basal third of the first phalanx, but may be almost entirely inclosed, as in *Thyroptera*. The extent of the enwrapping membrane determines the size of the little fold of skin which lies between the thumb and the second metacarpal bone. The thumb is relatively large in pendent forms, since it is here of value in prehension; *per contra*, in *Thyroptera*, in which genus a suctorial disk takes the place of a prehensile thumb, this digit is also small, though the animal is unadapted to activity in the prone attitude. It has been already noted (p. 5) that the thumb is bent downward and the under surface of the first metacarpal bone fairly well outlined in the pendent forms. It is not known how *Desmodus* and *Diphylla*, which process with large projecting thumbs, support the body when at rest. The claws on the feet are weak, and the animals are probably not pendent at rest. With these exceptions, the phyllostomines possess the semi-flexed thumb, as do all the other families excepting the molossines and vespertiliones.

Posterior limbs.—The innominate bone always exhibits a narrow rod-like ilium which occasionally projects slightly above the line of the ilio-sacral articulation, but as a rule is level therewith. The dorsum of the ilium is flat, in most forms, but it may be concave and broad, as in molossines, *Atalapha* and *Chilonycteris*. The pubis is, as a rule, defined in the males, but is absent and has a wide interval defined between the innominate bones anteriorly in the females. The shape of the ischium and of the thyroid foramen is subject to slight variation in genera and even in species. The innominate bone is in most forms distinct from the vertebral column. In molossines, *Chilonycteris*, and in rhinolophines, it is anchylosed, both at the sacro-iliac junction and the ischio-sacral or ischio-coccygeal junctions. *Chilonycteris* is an instance of the union last named. In all bats a disposition exists for the tuberosity of the ischium to approach the vertebral column, thus presenting a marked contrast to that seen in terrestrial quadrupeds. *Antrozous* exhibits a facet between the tuberosity and the first joint of the coccyx. The sloth is the only animal I can recall which exhibits a fixation of the ischium similar to that found in the bats. The ilio-pectineal spine is marked; often a large tubercle, it may be a needle-like spine. In *Hipposideros* it is of enormous length and is anchylosed to the ilium near its upper border.

The interest which attaches to the osteology of the hind extremity has led me to give in more detail the following:

In pteropines the ilium is curved outward to a slight degree at the crest. The ridge from the upper border of the acetabulum is inconspicuous and does not extend entire length of ilium; thus the ventral and dorsal surfaces are not separated and there is no special external border near the crest. The tuberosity of the ischium is deflected markedly from the line of the ilium and lies against the coccyx. The pubis is thickened inferiorly; the pectineal spine is absent or scarcely discernible.

In *Hipposideros* among the rhinolophines the ilium is expanded and is concave on both dorsal and ventral surfaces. The broad crest extends outward and unites by a broad thin flange to the tip of the long pectineal spine. Tuberosity of the ischium not projected backward; nearly the entire pubis and ischium converted into a broad plate of bone at the expense of the thyroid foramen. Symphysis pubis long, entire. The trochanters of the femur are drawn backward and approximated; the inner trochanter is the longer; the outer side of the shaft below the head furnished with a flange. The condyles small and separated by a wide notch. In the tibia the spine for hamstrings compressed. Internal tuberosity prolonged; no mallelus.

In phyllostomines the ilium is not deflected at crest. As seen in *Artibeus* the ridge above the acetabulum rudimental as in pteropines—the ventral and dorsal surfaces therefore scarcely distinguished. The external border below the crest is rugose and enormously thickened. The ischium is turned but slightly toward the coccyx. The inferior border of the pubis produced inward as a long blunt process and the upper border forms a long acicular process (pectineal eminence) which extends one-half the length of the ilium. The trochanters of the femur not carried back, the outer not separated from the head by a notch. The inner is much longer than the outer. The shaft at its inner side at the proximal fifths exhibits a conspicuous crest. The condyles are of equal size. Above them posteriorly is a depression (best marked over inner condyle) to receive in forced flexion the posterior border of the articular surface of the tibia. Intercondylar notch, pit-like. Proximal end of the tibia with scarcely any inward projecting process; malleolus none; tubercle for insertion of hamstrings markedly developed; surface for articulation with the fibula rugose.

In *Hemiderma* the innominate is much as in *Artibeus*, but the pubis not projecting or thickened; the pectineal spine but one-third the length of the ilium. The femur quite as in this genus, but the outer trochanter separated by a notch from the head. In *Macrotus* the innominate bone much the same as above, but the pectineal spine over one-half the length of the ilium. The trochanters of the femur approximated and carried well to the back of the shaft. The fibula only half the length of the tibia.

In *Mormops* the ilium is greatly compressed between the ventral and dorsal surfaces; first joint of the tail very long. The femur and tibia as in *Macrotus*. *Chilonycteris* in like manner exhibits a compressed ilium ossified to sacrum with broad rugose external border adjoining crest. Dorsal surface slightly concave and expanded. In both *Mormops* and *Chilonycteris* the tuberosity of the ischium is anchylosed to the sacrum. The pubis in the male of *Mormops* is bony and entire; in *Chilonycteris* it is less firmly defined. The pectineal spine in *Mormops* is two-thirds the length of the ilium. In *Chilonycteris davyi* it is remarkable for being nearly as long as this bone and bound by fibrous tissue to the vertebræ. In both of the genera of Lobostomidæ the trochanters of the femur are approximate, confluent, and carried well back of the head. Tibia and fibula much as in *Macrotus*.

In *Molossus* the innominate bone is compressed, expanded. It is concave dorsally with narrow iliac upper border slightly projecting. Pectineal spine one-third the height of the ilium. Pubic symphysis entire, bony. Tuberosity of the ischium projects well backward, but is free from the sacrum. The inner trochanter much larger than the outer; truncate with a downward projecting projecting spine, not carried backward. The outer trochanter separated from the head by a slight notch. Condyles equal in size; notch wide, shallow. Tibia straight with large malleolus.

In *Promops* the pelvis entire as in *Molossus;* characters much the same as in this genus, but the upper border of the ilium without spine and the tuberosity articulating with the sacrum, but not anchylosed thereto. Femur and tibia of the same character—the distal epiphysis of the femur narrower than the expanded shaft. In *Nyctinomus* the ilium as in *Molossus*, but the pubic bones free; femur and tibia the same.

In *Atalapha* the ilium is quite as in *Molossus*, but is not anchylosed to the sacrum. The pectineal spine blunt, rudimental; tuberosity of the ischium lies in the same line with ilium approaches sacrum, but is not articulated therewith. Both trochanters of the femur are carried backward as in Vampyri, but are not approximate; *i. e.*, they are visible from in front; the inner is the narrower, though they are of the same length. Condyles high and narrow, the inner scarcely the wider; notch narrow, deep. Tibia curved with medianly projecting inner tuberosity, malleolus scarcely discernible. Fibula entire; upper portion membranous. In *Antrozous* the ilium is anchylosed to the sacrum and in the male at least the symphysis pubis is well defined; the tuberosity of the ischium extends back of the line of the ilium and almost touches the sacrum. The pubic bone without a thickened inferior border. The femur and tibia much as in *Vespertilio*.

In *Vespertilio* the ilium is narrow, not expanded above and not concave posteriorly; the outer border scarcely thickened near the crest. The pectineal spine low, compressed, directed slightly forward, blunt,

scarcely higher than the acetabulum. The inferior border of the pubic bone greatly thickened near the symphysic line in the male. The innominate bone is lightly held to the sacrum and at the symphysis pubis. The inner trochanter of the femur equals the external. Both are small and the gluteal crest is scarcely larger than a flange which unites the inner trochanter to the shaft, thus making the femur unique. The inner condyle is slightly the larger and the notch narrow. The tibia with large projecting median spine at the proximal end; malleous distinct.

In *Adelonycteris* and *Lasionycteris* the parts quite as in *Vespertilio*, the pectineal spine slightly longer; the shaft of the femur just below the head less expanded.

Corynorhinus much as in *Vespertilio*, but the upper part of the femur much less expanded, the shaft near the trochanter scarcely at all.

The femur is without neck. The outer and inner trochanters are subequal, and of large size, the outer tending to become the larger as in the molossines. The outer side of the shaft below the trochanter is often marked by a flange in position of the third trochanter. *Hipposideros* and all phyllostomines show an inclination to the development of a conspicuous flange on the inner side of the shaft near the inner trochanter. This is most marked in *Chilonycteris*, *Mormops*, and *Natalus*. In the genera last named the trochanters are drawn backward, lie on the posterior surface of the bone, and are in close relation (resembling, with the head, the anterior end of a geometric larva), while as a rule they are on lines which answer to. the lateral ligaments of the knee joint. The condyles are approximate markedly unequal with a narrow intercondylar notch, the inner condyle being the larger, as is the rule, or wide apart with small condyles, as in molossines and rhinolophines. The tibia may be shorter than the femur, as in *Artibeus* and *Molossus*, but it is, as a rule, longer than that bone. The inner tuberosity is furnished with a horizontally-projecting process in vespertilionines; this is an excellent character defining the family. The tubercle for insertion of the hamstrings is most marked in strictly arboreal forms, as the pteropines. The malleolus is often rudimentary or absent, as in phyllostomines and rhinolophines. The fibula is uniformly imperfect above save in the molossines, where it is complete, or in *Antrozous*, where a membranous fillet continues the form of the bone to the inner tuberosity of the tibia.

The toes retain two phalanges to the first toe; all the others have three, but differ in their relative lengths. The first phalanx of the first toe is, so far as examined, longer than that of the other toes. In *Pteropus* the lengths of the toes from the second to the fifth gradually diminish. In *Chilonycteris* they abruptly increase, that of the second toe being one-third shorter than the fifth. In all bats the tarsus and calcaneum are elongate and exhibit the general character of these bones in mammals, in which little or no weight is borne upon the posterior extremities. Both bones are so disposed that the larger end of each is

directed proximally. In *Rhinolophus* the calcaneum enters into the ankle joint. In other forms the calcaneum is independent of the joint. In *Phyllostomidæ*, including *Natalus*, as well as in the genus *Rhychonycteris*, the calcar* is placed in axial line with the calcaneum. In other families it joins the calcaneum to its outer side at a well-defined angle. As a rule the astragalus and calcaneum are nearly of one size, but in the genus last named the calcaneum is notably the smaller (Am. Naturalist, Feb., 1886, 176).

GENERAL PLAN OF ANTERIOR EXTREMITIES IN FLYING VERTEBRATED ANIMALS.

From the above consideration it will be seen that the wing membranes possess various features which can be used in distinguishing the members of the order. But after what manner are the flying mammals distinguished from other flying vertebrates?

There are two distinct types of modification which the vertebrate skeleton has undergone in adapting the animal for flight, both of which depend upon some peculiarity in the structure of the anterior extremities; and in order to obtain a correct opinion of them we propose to cast a glance at each in turn.

Plan of bony structure of the wings of flying vertebrate animals.

a. Bones of carpus ununited distinct; flight maintained by dermal expanse.	I. Wing membrane supported by all fingers. *Bats* (Vespertilio), order of MAMMALIA. II. Wing membrane supported by the fourth finger only (which is immensely developed), the others remaining free. *Pterodactyles*, order of REPTILIA.
b. Bones of carpus united; flight maintained by dermal appendages.	III. Bones of metacarpus, two to three in number; feathers not radiating. *Living birds* (AVES)—class. IV. Bones of metacarpus, four in number; feathers radiating. *Archæopteryx* (AVES)—subclass.

a.

I. The Bat, in which the humerus is long and slender, with a small pectoral ridge. Ulna rudimentary. The radius constitutes the bulk of the forearm; carpus composed of six bones; the metacarpal bones, five in number, separate and distinct; the phalanges generally, two in number; thumb, and in some genera the index finger, surmounted by a claw.

II. The Pterodactyle, in which the humerus is short and straight, very broad at head, with angular and prominent pectoral ridge; ulna and radius distinct, of nearly equal size; carpus composed of five bones; metacarpus of four bones, separate and distinct; first finger with three joints, second with four, third with five, fourth with four joints, all provided with claws, with the exception of the fourth, which is remarkable for the extraordinary development of its several joints. It is from this last-mentioned finger to the base of the foot that the skin was stretched by which the animal was enabled to fly.

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*The calcar is an element of doubtful homology. It supports the free border of the interfemoral membrane, and is of the same significance as the accessory cartilage of the fifth manal digit.

b. III. The Bird, in which the humerus is curved, more or less slender; pectoral ridge prominent, not angular; ulna large, curved, not united with the slender and more diminutive radius; carpus or two bones; metacarpus of two, sometimes of three bones—the first being small and cylindrical, the other two of larger dimensions and united so as to form a bone resembling those of the forearm; ulnar phalanx of one joint, united to the radial, which is composed of two.

The power of sustaining flight not dependent upon the expansion of skin, but upon the excessive development of dermal appendages (feathers).

IV. The Archæopteryx agrees with the typical bird in general particulars, but differs in the number of metacarpal bones, which are here four in number: the first and second are slender, free and separate from one another; the third and fourth bear considerable resemblance to those of extant birds, in being large, stout, and closely approximated; but are not, however, united.

Flight is supposed to have been maintained in the same manner as in living birds.

In addition to the instances already given, certain fishes, as the *Exocœtus* and *Dactylopterus*, possess the power of sustainig true flight. The mechanism that lifts the body of the fish from the water, and upholds it for a short time in the air, is obtained in the pectoral fins, which, in these animals, are enormously developed. The structure of these fins is homologous to that of the anterior extremities of other vertebrates—their form alone being modified to adapt the animal to the medium in which it is placd. Thus we have, in each great subdivision of vertebrate animals, a representative capable of sustaining flight.

Another somewhat similar modification of the animal economy is met with in a few animals of arboreal habits. Here a peculiar arrangement of the skin is observed, which enables the possessor to break the force of downward leaps. In the Flying Lemur (*Galeopithecus*), in the Flying Squirrel (*Pteromys*), and in the Flying Opossum (*Petaurista*), the furred skin extends laterally from the sides of the body, and is attached to anterior and posterior extremities at the metacarpal and metatarsal regions respectively. The only instance of osteological development is obtained in the Dragon (*Draco volans*), a small lizard from Sumatra, in which long, transverse processes from either side of the lumbar vertebræ support a thin membranous growth which is capable of being opened and shut by means of muscles attached to the bony frame-work.

TEETH.

In describing the teeth the nomenclature of Prof. H. F. Osborn will be followed. The diagram herewith presented is copied from this writer's paper in the American Naturalist, December, 1888, p. 1072.

UPPER MOLARS.

Antero-internal cusp	Protocone.	pr.
Postero-internal cusp or sixth cusp	Hypocone.	hy.
Antero-external cusp	Paracone.	pa.
Postero-external cusp	Metacone.	me.
Anterior intermediate cusp	Protoconule.	pl.
Posterior intermediate cusp	Metaconule.	ml.

LOWER MOLARS.

Antero-external cusp	Protoconid.	pr^d
Postero-external cusp	Hypoconid.	hy^d
Antero-internal cusp or fifth cusp	Paraconid.	pa^d
Intermediate or antero-internal cusp (in quadritubercular molars)	Metaconid,	me^d
Postero-internal cusp	Entoconid.	en^d

The upper molar in most bats presents to an extraordinary degree depressions on the outer or buccal surface of the crown. Such depressions receive the name of "flutings" and are seen in the teeth of many mammals other than the bats, as for example in the moles and shrews among the Insectivora, in the Ungulata, and in a marked degree in an extinct genus described by Prof. Cope, *Lambdotherium*. "Flutings," while of no homological significance, furnish systematic characters, and will therefore be noted in the descriptions. Disposed so as to define two V-shaped figures the "flutings" extend as a sinuate commissure between the paracone and the metacone. Of the two Vs an anterior and a posterior will be distinguished. Each V has two limbs, a first and a second. In the third molar various degrees of loss of the system of flutings occur. Commonly the anterior V is retained while the second is lost, excepting the buccal half of the first limb, as in V fuscus, or the "fluting" is reduced to the anterior V, the palatal half of the second limb being lost, as in *Macrotus* and *Atalapha*. In the Bats of North America the least reduced last molars are seen in *Nyctinomus* and *V. hesperus*.

The tri-tubercular tooth which results from the presence of the three cusps, the protocone, the paracone, and the metacone, may be connected with a triangular figure by bands which unites the cusp-points. These bands will be named in this monograph the commissures. In the molars of the bat such a triangle is seen whose apex is palatal and constituted of the protocone and whose commissure extends from this cusp to the paracone and metacone. Its base is the extraordinarily sinuate ("fluted") buccal surface of the crown. A careful search must be made for the true positions of the sides of this triangular figure for they lie on the opposed sides of the teeth and are inconspicuous. The crown at the "flutings" is of great vertical extent and dwarfs even the proportions of the protocone. When seen in profile the proportions between the size of the "columns" of the two V's and the "cusp" of the protocone afford materials for interesting comparisons in the different genera. The hypocone presents excellent subordinate characters. It is a development of the cingulum. Usually flat, as in *Macrotus*, it may be a sharply defined as in *Promops perotis*, or provided with a sharp cusp as in the exotic genus *Noctilio*. The cingulum can be traced as a delicate ridge which lies basal to the sides of the tritubercular triangle. It varies greatly in extent, being best developed in *Nyctinomus*.

In the lower molar scarcely any fluting is present and the plan of the tooth is simple. The protoconid, paraconid, and melaconid are united

by commissures. The apex of the triangular figure is buccal. The heel or hypoconid is large. It is united to the triangle by a commissure at the lingual side. Such a commissure is provided with a sharp cusp in *P. perotis*, but as a rule it is smooth.

KEY TO GENERA.

I. Bats with median appendage to nose, four incisors in lower jaw... PHYLLOSTOMIDÆ.

a. Body massive, auricle shorter than head, not united with its fellow.. *Artibeus*.

a[1]. Body slender, auricle as large or longer than head, united with its fellow .... *Macrotus*.

II. Bats without median appendages to nose.

b. Nostrils circular, wings narrow and pointed; tail long, produced far beyond interfemoral membrane; marginal toes fringed with coarse hair. MOLOSSI.

Lips grooved.. *Nyctinomus*.

Lips not grooved.. *Promops*.

b[1]. Nostrils elliptical, wings broad, ample; tail as long or only slightly longer than the broad interfemoral membrane; marginal toes naked .... VESPERTILIONIDÆ.

c. Two incisors in upper jaw.

† Six incisors in lower jaw.

* Interfemoral membrane more or less hairy.

Premolars $\frac{1}{2}$ .... *Dasypterus*.

Premolars $\frac{2}{2}$ .... *Atalapha*.

** Interfemoral membrane not hairy .... *Nycticejus*.

†† Four incisors in lower jaw.. *Antrozous*.

c[1]. Four incisors in upper jaw.

† Premolars $\frac{1}{2}$; greatest width of tragus at base equals one-half of inner border.. *Adelonycteris*.

†† Premolars $\frac{2}{2}$.

* Greatest width of tragus equals much less than one-half inner border; nose simple, ears separate.. *Vesperugo*.

** Greatest width of tragus equals one-third height of inner border; auricles united.

§ Nose with lateral club-shaped gland-masses.................. *Corynorhinus*.

§ § Nose without lateral club-shaped gland-masses.................. *Euderma*.

††† Premolars $\frac{2}{3}$; greatest width of tragus at middle and equals two-thirds height of inner border .... *Lasionycteris*.

†††† Premolars $\frac{3}{3}$. Lips whiskered, dorsum of face furred...... *Vespertilio*

NOTES ON THE GENERA OF VESPERTILIONIDÆ.

BY HARRISON ALLEN, M. D.

At the conclusion of a study of this family I venture to place on record my views respecting the position of the genera Antrozous, Corynorhinus, Synotus, Noctulinia, and Kerivoula.

Antrozous.—*Antrozous* is a composite genus. It is not specially related to *Corynorhinus* and *Plecotus*. In the incomplete tympanic bone, in the absence of the palatal plate to the premaxilla, in the markings on the fourth digital interspace, in the shape and relation of the ulna, in the possession of a tubercle on the palmar surface of the trapezium, in the details of the molars, in the arrangement of the nasal scrolls, and in the deflection of the cartilage of the fourth digit toward the thumb, *Antrozous* is in alliance with *Vespertilio*. It is distinguished therefrom by the absence of the accessory cartilage to the fifth digit. Affinity with *Corynorhinus* is suggested by the shape of the muzzle-glands. *Antrozous* resembles *Atalapha* in the shapes of the last molars as well as in the proportions of the hypoconid, but in the presence of four incisors in the lower jaw,* in the free lower lip, in the head not being in axis with the body, in the manal formula, in the disposition for the nostril to bear a vertical internarial ridge and the upper border of the muzzle a constant transverse outgrowth, in the presence of a hem of membrane on the pollical side of the second metacarpal bone, recalls the Phyllostomidæ.

Corynorhinus.—This genus is in close relation to *Euderma* and *Plecotus*, so the term Plecoti adopted by Dobson is a useful one to be employed in this restricted sense for the genera above named. I would exclude from the group *Antrozous* and *Synotus*. *Nyctophilis* and *Otonycteris* I have not studied. *Corynorhinus* differs from *Antrozous* in the greater development of the hypocone in the upper jaw and its equivalent in the lower jaw. The points of the cusps are more produced than in the genus last named. The thumb is semiflexed (thus denotive of free motion in the carpo-metacarpal joint), the callosity is rudimentary. The palmar aspects of the manal digits are well defined at the proximal ends, being thus without the radiated raised folds of the skin seen elsewhere in the family. The terminal cartilages of the digits

* In the restriction of the lower incisors to four in a family where the dominant number is six it is of interest to note that in *Nyctinomus brasiliensis* the third incisor on each side is rudimental or may be lost, thus reducing the number from six to four.

are axially disposed to their respective phalanges, a character not seen in *Antrozous* or in the Vespertilionidæ other than in the Plecoti. The third metacarpal bone is relatively short, a character often met with in the Phyllostomidæ. The trapezium is without a palmar tubercle, again a character of the family last named. The sphenoid foramen lies at the bottom of a deep recess. The interphalangeal joint of the fifth digit is freely movable. *Corynorhinus* thus shows characters which distinguish it from the vespertilionine group and relate it to the Phyllostomidæ.

Synotus.—*Synotus* exhibits the tubercle at the base of the trapezium; the terminal cartilage of the fourth digit is not axial, as in *Corynorhinus*, but is deflected toward the thumb. In like manner the first metacarpal bone is not freely movable at the carpometacarpal joint, as in *Antrozous* and the Vespertilionidæ generally. The interphalangeal joint of the fifth digit is semianchylosed. These characters indicate an increased strain on the wing membrane as compared with *Corynorhinus*, where the joint movements are freer, and places the genus in close alliance to *Adelonycteris*, *Vesperugo*, and *Vespertilio*, while removing it from the Plecoti.

Noctulinia.—This genus was established by J. E. Gray (Ann. and Mag. N. H., 1842, x, 255). Jerdon (Mammals of India, 1867) considers the genus valid, though zoologists generally have followed Keyserling and Blasius (Wiegm. Archiv, 1839, p. 317), who include the noctule bat in their genus *Vesperugo*. I propose to rehabilitate *Noctulinia*. It is quite distinct from *Vesperugo*, notwithstanding the similarity in the number of the teeth.* A rudiment of a biceps muscle is present in

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* The following is quoted from Jerdon's "The Mammals of India," Roorkee, 8vo, 1867, p. 36:

Gen. **Noctulinia**, Gray.

Feet quite free from the membrane, which is attached to the ankle only; otherwise as in *Scotophilus*. Incisors, $\frac{4}{6}$; molars, $\frac{5-5}{5-5}$; by age, $\frac{4-4}{4-4}$; with a very small false molar.

Noctulinia noctula.

Vespertilio apud Schreber.—*V. lasiopterus*, Schreber.—*V. altivolans*, White.—*V. labiata*, Hodgson.—Blyth, Cat. 89.

The Noctule Bat.

Description.—Ears remote, oval-triangular, or rounded, wide, extending nearly to the angle of the mouth; tragus short, broad, curved, ending in a broad rounded head; muzzle short, blunt, nude; lips somewhat tumid; fur dark, reddish-brown, both above and below.

Length, 4$\frac{1}{4}$ to 5 inches, of which the tail is nearly 2; expanse, 14 to 15 inches; forearm, 1$\frac{9}{12}$.

This fine bat has been sent from Nepal by Hodgson, who states that it is found in the central hills of Nepal. It is not uncommon in England, and its flight is lofty.

[The above extract includes the short statement of Gray regarding the manner of the attachment of the wing to the ankle and the indication of affinity of the genus to *Scotophilus*. It remains clear that my diagnosis as now given is the first offered of the genus *Noctulinia*. I have not studied *Vesperugo leisleri*, which is placed in the same group with the noctule bat. H. A.]

the thigh. The penis is provided with a bone. The muzzle is separated from the upper lip by a naked, smooth space. The lower border of the muzzle is not continuous with the upper border of the muzzle, but ends upon the sides of the face to form the lower border of a groove, the upper edge of which constitutes a distinct ridge at the side of the muzzle.

The lower lip presents a well-defined triangular mental plate; at the side the lip forms a thick rounded border. A deep groove lies below this border, which is limited in part by a low fold of skin almost joining the auricle as it ends near the angle of the mouth.

The proximal ulnar rudiment is anchylosed to the radius, and provided with a filamentous shaft. The pisiform bone is massive and lies parallel to the fifth metacarpal bone. Both the above characters are present in *Atalapha* and *Dasypterus.**

Noctulinia and *Atalapha* and its allies (I would place here *Miniopterus*) are thus seen to possess molossine affinities. The disposition for all the forms named to possess hairy wing membranes and the tragus to be of the same general character are also in evidence that they incline to form an alliance.

Kerivoula.—J. E. Gray showed good judgment in separating this genus from *Vespertilio.* The more the forms are studied the wider the interval will become which removes them from one another. In a study of *K. hardwickii* I found no trace of a phalanx in the second digit. The phalanges of the third digit were of the same length; those of the fourth digit were very unequal, the second being the shorter, while in the fifth digit the second phalanx was almost the length of the first. There was apparently no accessory cartilage at the side of the end of the fifth digit. There was no oblique tibial line on the wing membrane. I know of nothing similar to this in the family. Seven rugæ were seen on the hard palate. The ulna was anchylosed to the shaft at its middle, a character broadly contrasted to *Vespertilio* but but resembling that seen in the majority of the order. The first metacarpal bone was bound down its entire length to the second matacarpal and its callosity covered the entire palmar surface. A fleshy wart was found on the dorsal aspect of the forearm at the elbow.

* Proceedings of Am. Philosoph. Soc., XXIX, February 11, 1891.

NOTES ON A FEW FOSSIL PLANTS FROM THE FORT UNION GROUP OF MONTANA, WITH A DESCRIPTION OF ONE NEW SPECIES.

BY

F. H. KNOWLTON.

(With Plates I-II.)

The material which is the basis for the following notes was obtained by exchange from the University of Minnesota through Prof. C. W. Hall, the professor of geology in that institution. It consists of a single slab which bears no less than nine beautifully preserved leaves upon its surfaces. It was collected by Prof. A. D. Meeds, also of the University of Minnesota, during the summer of 1884, and is labeled "Southern Montana;" but, from the nature of the matrix as well as from the species of plants preserved upon it, it is more than probable that it came from the Yellowstone River, not far from the town ot Glendive, Mont.

The first material from this part of the country was obtained by Dr. F. V. Hayden, while attached to an expedition made by Lieut. G. K. Warren, of the U. S. Army, in the summer of 1856.* This expedition proceeded from St. Louis to the mouth of the Yellowstone, at which point they arrived July 10, 1856. They intended navigating the Missouri River from this point to Fort Pierre in a small boat; but, as this could not be procured for some weeks, they spent the intervening time (until September 1) in exploring the Yellowstone as far up as the mouth of the Powder River.

Plants were also probably obtained during the years 1859 and 1860 by Dr. Hayden, who accompanied the exploring expedition under Capt. (later General) W. F. Raynolds to the Yellowstone and Missouri rivers.† The plants obtained at these times were described by Dr. J. S. Newberry in 1867.‡ This material had come, according to Dr. Newberry, from various points on the Missouri River, at Fort Clarke, Red Spring, Fort Berthold, and from 100 miles below old Fort Union, at

*Preliminary report of explorations in Nebraska and Dakota in the years 1855, 1856, and 1857, by Lieut. G. K. Warren, topographical engineer U. S. Army. Reprint, Washington, 1875.

†Exploration of Yellowstone and Missouri rivers under direction of Capt. W. F. Raynolds, 1859-'60. Washington, 1869.

‡Later extinct floras of North America. Annals of the N. Y. Lyc. of Nat. Hist., vol. IX, 1868, pp. 27-76.

the mouth of the Yellowstone, and on the Yellowstone, at O'Fallon's Creek, 100 miles above where the Yellowstone joins the Missouri, and in the valley of the Yellowstone between this point and its mouth.

Much additional material from the same general region was obtained by Dr. C. A. White and Prof. Lester F. Ward, of the present Geological Survey, during the years 1881–1883. Prof. Ward's material came from the Yellowstone in the vicinity of Glendive, Mont., and the results of a preliminary examination of it are published in the Sixth Annual Report by the Director for the year 1884–'85 (pp. 542 *et seq.*) and also as a special bulletin (Types of the Laramie Flora, Bull. U. S. Geological Survey No. 37). Prof. Ward's material, it will be observed, is from practically, the same region as much of that obtained by Dr. Hayden, and, as shown both by the matrix and by the species represented, some of the material must have come from practically the same spot.

DESCRIPTION OF THE SPECIES.

Thuya interrupta Newby.

Later Extinct Floras, p. 42; Illustrations of Cret. and Tert. Plants, Pl. XI, Figs. 5, 5*a*.

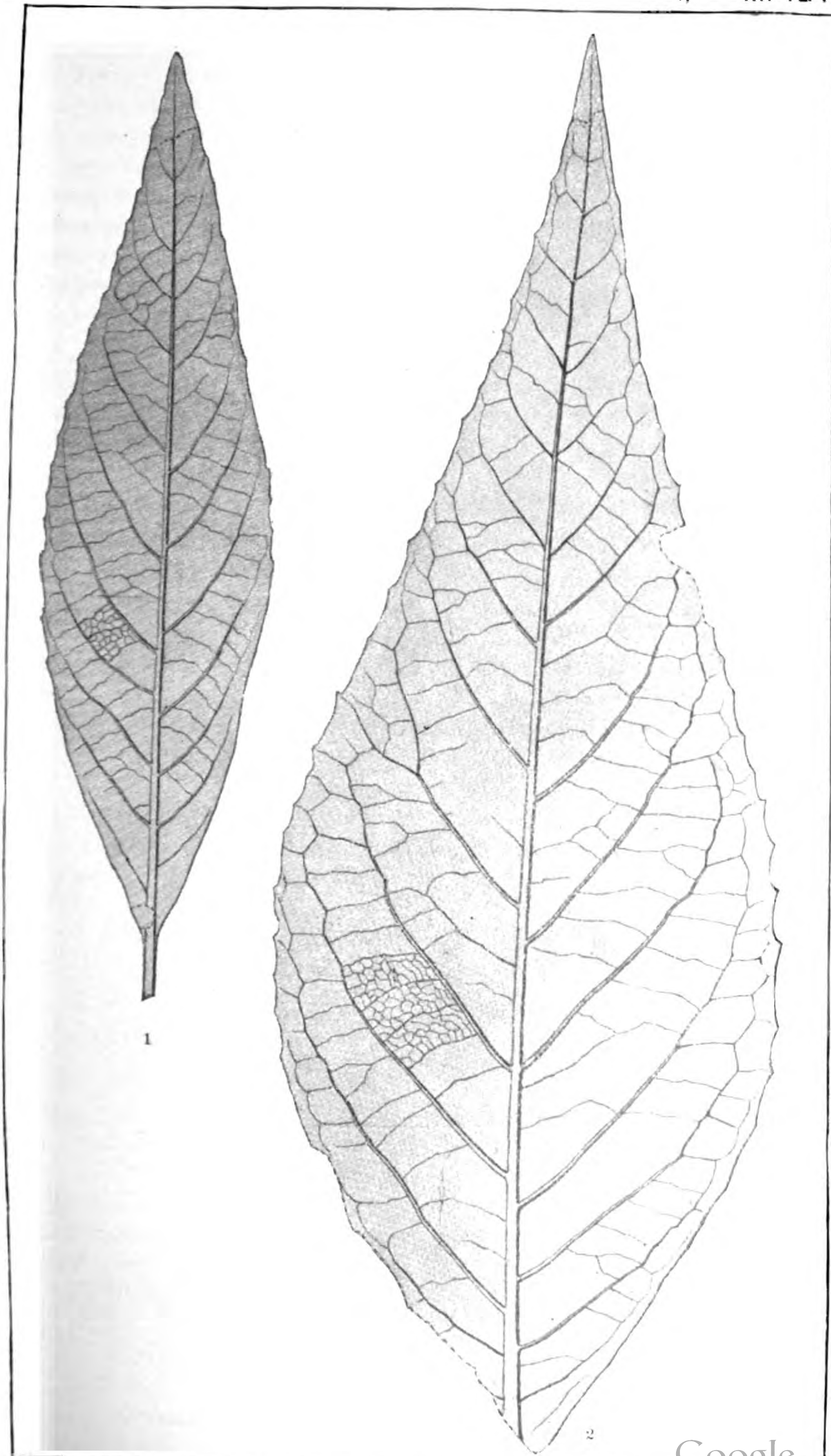
This beautiful species has not before been obtained, so far as I know, since the original specimens were collected by Dr. Hayden, near Fort Union. The slab obtained by Prof. Meeds bears a single small, but highly characteristic branch of this conifer.

Populus Meedsii, sp. nov.

Pl. I, Figs. 1, 2.

Leaves short-petioled, 12 to 20^{cm} long, 3 to 7^{cm} broad, long-lanceolate, usually being broadest in the middle, from which point they taper gradually downward into a wedge-shaped base and upward into a similarly shaped, rather acute apex; lower third of margin smooth, remainder provided with very short outwardly pointing teeth separated by shallow sinuses; midrib strong, straight; secondaries, 12 to 14 pairs, alternate or subopposite, emerging at an angle of 45° or 50°, running straight toward the margin, along which they arch, forming a nearly regular series of quadrangular meshes, and from which slender branches enter the weak teeth; tertiaries strong, forming lattice-like bars nearly at right angles to the midrib or in some cases more nearly at right angles to the secondaries; ultimate nervation fine, quadrangular.

This beautiful species, which I take pleasure in naming in honor of Prof. Meeds, the collector, seems to find its nearest living analogue in *Populus angustifolia* James (*P. balsamifera* var. *angustifolia* Watson), a species still living along streams from New Mexico and Colorado to California and Washington. The living species differs merely in having the leaves more nearly ovate-lanceolate and in being crenate-serrate with numerous fine teeth. The nervation is quite similar in both, being, however, less regular and with the secondaries at a more acute angle



Populus meedsii, new species.

in *P. angustifolia.* It is certainly quite remarkable that the fossil and living species should be so intimately associated, and seems to warrant the supposition that *P. Meedsii* represents an undoubted ancestral form of the living *P. angustifolia.*

Populus Meedsii is also evidently related to *P. Heerii* Sap.* from the Eocene at Florissant, Colorado. This latter species has the leaves long-petioled, ranging in size from 5 to 30^{cm} in length and 2 to 12^{cm} in width. They differ slightly in shape, being in general broadest below the middle, and have sharp upward-pointing teeth, separated by acute sinuses. The nervation is nearly the same in both. It is probable that *P. Heerii* is even more closely related to the living *P. angustifolia* than is *P. Meedsii*, which accords well with its geological position. If this view of the relationship between them be correct, our present knowledge of the development will stand as follows:

Populus Meedsii sp. nov. Fort Union Group. Lower Eocene.
Populus Heerii Sap. Green River Group. Upper Eocene.
Populus angustifolia James. Living.

Quercus Dentoni Lx.

Cret. and Tert. Floras, p. 224, Pl. XLVIII, Figs. 1, 11; Ward, Types of the Laramie Flora, p. 26, Pl. X, Fig. 1.

The type specimens of this species were obtained by Prof. William Denton from the Bad Lands of Dakota, but probably not far from the mouth of the Yellowstone, therefore practically in the same region.

The single partly broken leaf on the slab obtained by Prof. Meeds differs slightly from the figures given by Lesquerewx, being broader and having the secondaries less arched. It is more like the leaf referred to this species by Prof. Ward from Point of Rocks, Wyoming.

Dryophyllum, cf. **D. aquamarum** Ward.

Types of the Laramie Flora, p. 26, Pl. X, Figs. 2–4.

The type of this species came from Point of Rocks, Wyoming. The leaf under consideration is much broken and it is impossible to make a positive identification.

Pterospermites Cupanioides Newby. sp.

Pl. II, Fig. I.

Phyllites Cupanioides Newby., Later Extinct Floras, p. 74; Illustrations of Cret. and Tert. Plants, Pl. XXVI, Figs. 3, 4 (wrongly identified by Lesquereux as *P. venosus*).

Pterospermites Whitei Ward, Synopsis of the Flora of the Laramie Group, p. 556, Pl. LVI, Figs. 5, 6; Types of the Laramie Flora, p. 94, Pl. XVI, Figs. 5, 6.

Leaves large, 12 to 13^{cm} long, 7 to 8^{cm} broad, fleshy, ovate, elliptic in outline, rounded or heart-shaped at base, subacute at summit,

* Lesquereux: Cret. and Tert. Floras, p. 157, Pl. XXX.

margins coarsely and obtusely sinuate—toothed above, simple or waved below; petiole 4 to 6^{cm} long, straight, very thick; nervation pinnate; very strong; midrib straight or slightly flexuose; lateral nerves about six pairs, somewhat crowded below, more remote above, alternate, basilar pair usually short and simple and uniting above with the tertiary branches of the second pair to form a marginal festoon; middle secondaries each bearing one or two, rarely three, branches near the summit, upper ones generally simple; tertiary nervation very distinct, forming lattice-like bars connecting the secondary nerves at right angles.

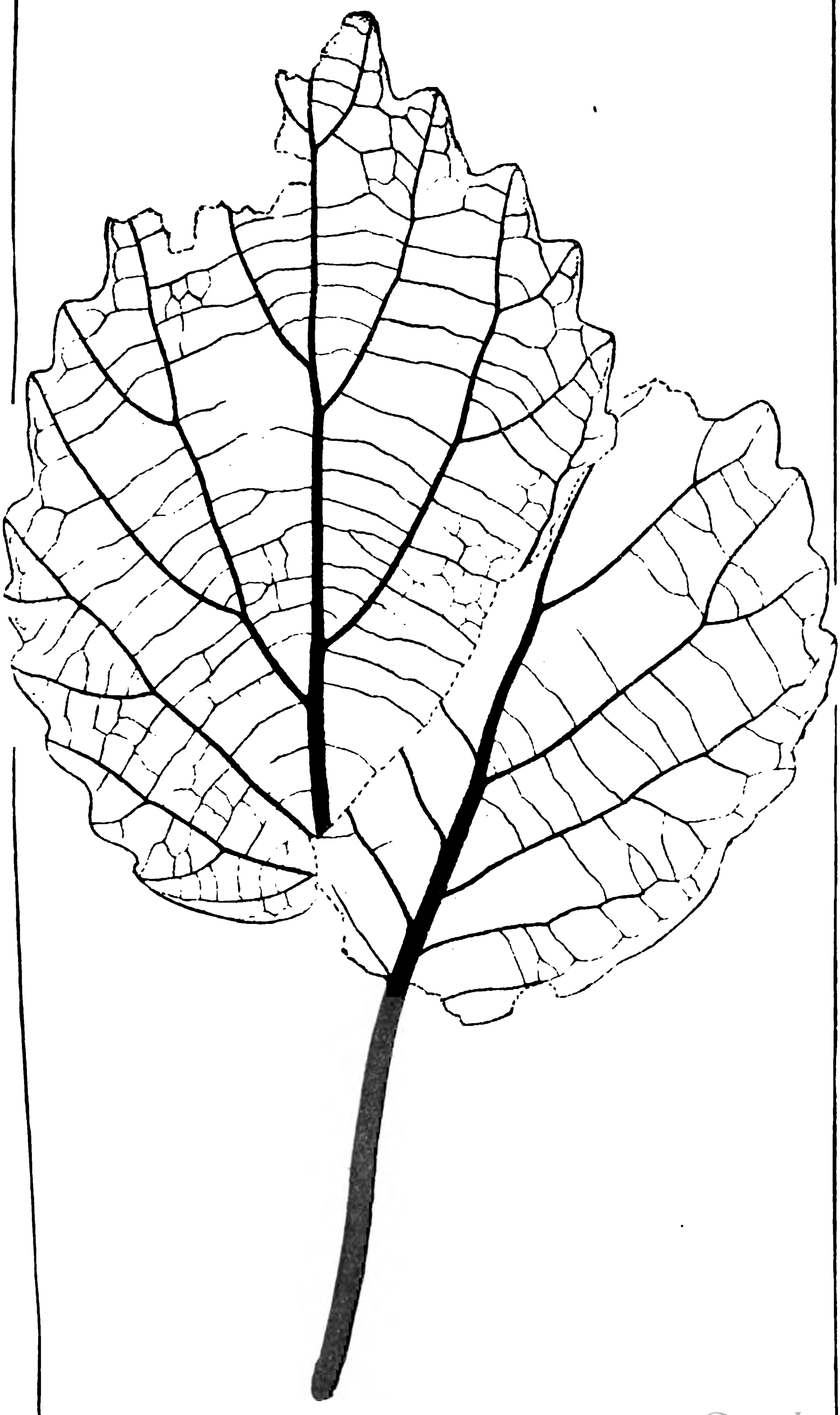
The above description is, with slight modification, the one given by Dr. Newberry (loc. cit.) for this *Phyllites Cupanioides*, the changes being simply relatively unimportant details afforded by later and in some respects more perfect material than he evidently had at his disposal. It will also be observed that this description does not differ essentially from that given by Prof. Ward for his *Pterospermites Whitei.* A comparison of the figures of the latter species with those given by Newberry and also with the ones under discussion shows that they agree essentially, the differences being insufficient to permit a generic or even a specific separation. The leaves figured by Prof. Ward are a little less strongly toothed and more markedly heart-shaped at base. The nervation is the same in both.

Dr. Newberry's specimens are labeled "Fort Union, Dakota," which is in the vicinity of the mouth of the Yellowstone; but, as the Fort Union group is exposed in practically identical material from above the mouth of the Powder River to the Missouri at the mouth of the Yellowstone, they are shown to be from similar if not identical beds. Several of Dr. Newberry's types are in the collections of the United States National Museum and are seen to agree exactly with the present and other material from the Yellowstone.

Viburnum asperum Newby.

Later Extinct Floras, p. 54; Illustrations of Cret. and Tert. Plants, Pl. XVI, Figs. 8, 9.

A single, considerably broken leaf seems to belong to this species. The type specimens were obtained by Dr. Hayden near Fort Union.



Pterospermites cupanioides Newberry, sp.

ON A COLLECTION OF BATRACHIANS AND REPTILES FROM MOUNT ORIZABA, MEXICO, WITH DESCRIPTIONS OF TWO NEW SPECIES.

BY

W. S. BLATCHLEY.

While a member of the Scoville expedition to Mount Orizaba, Mex., in the summer of 1891, the writer made a small collection of batrachians and reptiles, which furnishes the basis of the present paper.

The collection was made about the city of Orizaba at a height of 4,000 feet above sea level, and on the southwestern slope of the mountain between the heights of 8,000 and 14,000 feet.

No special effort was made to secure specimens of either class, only such being taken as came readily to hand while collecting insects. The collection is not to be viewed, therefore, as a representative one for the localities mentioned.

My thanks are due to Dr. O. P. Hay, of Irvington, Ind., for the loan of books and other aids, and to Mr. Leonhard Stejneger, of the U. S. National Museum, for the loan of specimens for comparison. The types of the new species have been deposited in the U. S. National Museum.

BATRACHIA.

URODELA.

PLETHODONTIDAE.

SPELERPES Rafinesque, 1832.

Spelerpes bellii Gray.

"Cat. Brit. Mus., 1846, 46," Boulenger, Cat. Batrach. Grad. Brit. Mus., 1882, 68. Cope, Batrach. N. A., 1889, 161.

This was the most common salamander on the slope of the mountain, numerous specimens having been taken from 8,000 to 14,000 feet, at which latter height it was frequent beneath stones and the bark of logs. At 12,000 feet three specimens were taken which were uniform plumbeous above, the series of yellow spots usually present being wholly obsolete. These were the largest specimens secured and measured respectively 146, 153, and 167^{mm} in total length. Among the others the young had the series of spots most distinct, but in all the spots in life were yellow, not red, as stated by both Boulenger and Cope.

U. S. National Musium, Nos. 19263–19265.

Spelerpes orizabensis, sp. nov.

Palatine teeth, separated from parasphenoids by a wide interspace; extending externally beyond the nares. Parasphenoid patches separated, scarcely diverging posteriorly. Head long and narrow, but little wider than body; greatest width, which is at angle of jaws, contained one and three-fourth times in distance from snout to gular fold. Snout short and blunt; nostrils and eyes small. Body cylindrical, elongate, measuring from three to three and a half times the distance from snout to gular fold.* Limbs weak, the digits slender and margined, but not webbed at base. Tail cylindrical, tapering gradually to a point, slightly restricted at base, a little shorter than head and body. Gular fold distinct; twelve costal grooves.

General color, after immersion in alcohol, plumbeous; the body with a broad reddish-brown dorsal stripe which is blotched here and there with small dark spots and margined below by a band of gray which extends from angle of jaw to base of tail and is broken into patches by the black costal grooves.

In life, the dorsal stripe was a bright red and unbroken, very similar to but brighter than that of *Plethodon cinereus erythronotus* Green. In alcoholic specimens the darker blotches appear.

Measurements: Total length, 96^{mm}; snout to cloaca, 50^{mm}; snout to gular fold, 12^{mm}; width of head, 7^{mm}; length of fore limb, 11^{mm}; of hind limb, 12.5^{mm}; of tail, 46^{mm}; distance from axil to groin, 32^{mm}.

S. orizabensis differs from *S. leprosus* Cope in possessing a notably longer and narrower head; a blunter snout; a much less divergence of the parasphenoid patches; a more elongate body, the distance from axil to groin being exactly one-third the total length, whereas in *leprosus* it is very slightly more than one-fourth; a shorter tail; more slender and less depressed digits, and in color.

Three specimens were taken from between the bark and wood of a large spruce log, at the height of 11,000 feet on the slope of Mt. Orizaba.

U. S. National Museum, Nos. 19266–19267.

Through the kindness of Mr. Leonhard Stejneger, a bottle containing five specimens of *Spelerpes*, belonging to the U. S. National Museum, and taken at Orizaba by Prof. Sumichrast, was forwarded to me for comparison. In a letter accompanying the specimens Mr. Stejneger expressed the opinion that one of them was an undescribed species. This, after a careful examination, I find to be the case, and, with the consent of Mr. Stejneger, the following description is herewith inserted:

Spelerpes gibbicaudus, sp. nov.

Palatine teeth in two nearly straight series, extending externally beyond the nares; separated from the parasphenoids by a well-marked interspace. Parasphenoid patches long, separate, diverging

* The extreme length of head renders this proportion comparatively small.

but slightly posteriorly. Head narrow, but little wider than body, not depressed; greatest width contained one and a half times in distance from snout to gular fold. Body cylindrical, elongate, measuring over three and one-half times the distance from snout to gular fold. Fingers and toes short, not webbed at base. Tail cylindrical, shorter than head and body, and of almost the same diameter of body for three-fourths of its length, then tapering rapidly to a blunt point. Skin not wrinkled, but very closely pitted, the pits, beneath the lens, resembling circular scales. Gular fold distinct. Twelve costal grooves. Color uniform brown; the center of the dermal pits on dorsal surface of body and ventral surface of tail yellow, giving those regions the appearance of having been sprinkled with yellow dust. This appearance may be due to the action of alcohol.

Measurements: Total length, 85^{mm}; snout to cloaca, 46^{mm}; snout to gular fold, 10^{mm}; width of head, $6\frac{2}{3}^{mm}$; length of fore limb, 10^{mm}; of hind limb, 11^{mm}; of tail, 39^{mm}; distance from axil to groin, 31^{mm}.

From *S. leprosus* Cope, this species may be known by the straighter palatine teeth; the less divergence of the parasphenoids; the narrower head; the proportionally more elongate body; the unwebbed toes, and the shorter and much stouter tail.

One specimen, U. S. National Museum, No. 19255, collected at Orizaba, Mexico, by Prof. Sumichrast.

ANURA.

BUFONIDÆ.

BUFO Laurenti, 1768.

Bufo intermedius Günther.

Boulenger, Cat. Batr. Sal. Brit. Mus., 1882, 307.

A single specimen of *Bufo*, taken from the gutter in a street of the city of Orizaba, varies from the description given by Boulenger, loc. cit., as follows: The hind limb is longer, as, being carried forward along the body, the tarso-metatarsal articulation reaches the anterior border of orbit, instead of "to the eye." The color of *intermedius* is given as "olive above, with irregular, sometimes confluent, dark spots; belly immaculate or with slight spots." The specimen in hand is dark olive above, with a narrow ash gray (white in life), dorsal line extending from snout to anus. On top of the head this line widens, forming an ashen cross-band which extends across the anterior half of eyelids and the intervening frontal space. Sides and belly white with numerous small dark spots. Limbs with many large olive spots; front ones immaculate beneath. Length, 42^{mm}.

U. S. National Museum, No. 19268.

HYLIDÆ.

HYLA Laurenti, 1768.

Hyla eximia Baird.

U. S. and Mex. Bound. Surv., II, 29; Pl. XXXVIII, Figs. 8–10. Boulenger, Cat. Batr. Sal. Brit. Mus., 1882, 378.

Several specimens of this handsome tree frog were secured from the leaves of bushes in the gardens about Orizaba. When on the leaves the general color was a bright pea green, instead of olive as given in the descriptions, loc. cit.

Hyla miotympanum Cope.

Proc. Acad. Phil., 1863, 47." Boulenger, Cat. Batr. Sal. Brit. Mus., 1882, 400.

This species was quite common about the city of Orizaba, on tall grass and the leaves of shrubs. One specimen was also taken at a height of 8,000 feet, near San Andres.

REPTILIA.

LACERTILIA.

IGUANIDÆ.

SCELOPORUS Wiegmann, 1828.

Sceloporus variabilis Wiegmann.

Herp. Mex., 1834, 51. Boulenger, Cat. Liz. Brit. Mus., II, 236.

Frequent at Orizaba and as high as 14,000 feet on the mountain. About the city it was most often seen on the stone walls surrounding the gardens, especially in the suburbs. A single specimen, a ♂ measuring 146mm in length, was secured there, and three others on the mountain slope, all of which were smaller.

Sceloporus æneus Wiegmann.

Herp. Mex., 1834, 52. Boulenger, Cat. Liz. Brit. Mus., II, 233.

Three specimens of this lizard, two ♂ ♂ and a ♀, were taken from the slope of the mountains at a height of 12,000 feet, and another, a ♂, at a height of 14,000 feet. Others were seen, but could not be captured, on account of their swiftness.

Measurements—adult ♂:

	Millimeters.
Total length	91
Length of head	11
Length of body	35
Length of tail	45

In the field it is difficult to separate *æneus* from *variabilis*, as from above they are quite similar in appearance. When captured, however,

the larger size of the lateral scales, the greater prominence of the femoral pores, and the brilliant blue mottlings on the ventral surface of the ♂ of *æneus* easily distinguish them. Moreover, *æneus*, when full grown, is a smaller species than *variabilis*.

Sceloporus microlepidotus Wiegmann.

Herp. Mex., 1834, 51. Boulenger, Cat. Liz. Brit. Mus., II, 232.

The small-scaled lizard was the most abundant species on the slope of the mountain from 9,000 to 14,000 feet. They were continually seen along the pathway, and when pursued took refuge beneath fallen rocks or in the clumps of dense bunch grass. One was surprised at a height of 14,000 feet, with a half-eaten beetle, a species of *Lachnosterna*, in his mouth, and was chased quite a distance before he dropped his prey.

The species is at once known by the small size of the dorsal scales, there being on an average about seventy-five between the occipital plate and the base of tail. Four males, five females.

PHRYNOSOMA Wiegmann, 1828.

Phrynosoma orbiculare Wiegmann.

Herp. Mex., 1834, 53. Girard, Stansb. Rep. Grt. Salt Lake, 1852, 359. Boulenger, Cat. Liz. Brit. Mus., II, 241.

This, the only species of "horned toad" taken, was common in the fields about San Andres, between 7,500 and 9,000 feet, but was seen at no other locality. Those secured evidently belong to the variety *Cortezii* Bocourt, as the occipital spines are shorter than the longest temporal ones and the head is broader than long.

Measurements—adult ♀:

	Milimeters.
Total length	131
Length of head	19
Width of head	24
Length of body	69
Length of tail	43
Length of fore limb	34
Length of hind limb	42

ANGUIDÆ.

GERRHONOTUS Wiegmann, 1828.

Gerrhonotus imbricatus Wiegmann.

Herp. Mex., 1834, Pl. x, Figs. 2, 5. Boulenger, Cat. Liz. Brit. Mus., II, 272.

A single specimen of this genus was captured on the slope of the mountain at a height of 11,000 feet. It was creeping slowly through the bunch grass, which, at that height, covered the soil, and when discovered made but little effort to escape, but darted forth its tongue rapidly after the manner of a snake.

The ventral scales are in twelve longitudinal series; but in the outer row on both sides several scales have been divided, giving thirteen to fourteen scales in some of the transverse series. The fore limb, when oppressed, reaches the posterior instead of anterior corner of eye; otherwise it agrees fully with the description cited.

Measurements: Total length (tail defective), 216^{mm}; length of head, 29^{mm}; of body, 94^{mm}; of tail (reproduced), 93^{mm}; of fore limb, 27^{mm}; of hind limb, 35^{mm}.

U. S. National Museum, No. 19262.

HIGH SCHOOL BIOLOGICAL LABORATORY,

Terre Haute, Indiana, September 14, 1892.

DESCRIPTION OF TWO SUPPOSED NEW SPECIES OF SWIFTS.

BY
ROBERT RIDGWAY.
Curator of the Department of Birds.

Chætura lawrencei, sp. nov.

SP. CHAR.: Similar to *C. guianensis* Hartert, but smaller, longer upper tail-coverts darker (outer web almost wholly glossy blackish), and flanks paler slate-gray, in marked contrast with the glossy black under tail-coverts. Wing, 3.85–4.20; tail (to base of spines), 1.35–1.45.

HABITAT: Grenada, West Indies; also, Tobago, and Trinidad, or Venezuela?

Type, No. 84841, U. S. National Museum, ♀ adult, Grenada, May 7, 1881; J. G. Wells. (Length, 4½ inches, extent of wings, 10 inches.)

An example in the collection of Messrs. Salvin and Godman, of uncertain locality (labeled "Venezuela?") is quite identical with the type in coloration, but is considerably smaller, the length of the wing and tail being the minimum of those given above. It is labeled "*Chætura salvini* Hartert" (unpublished synonym of *C. guianensis* Hartert); but, having a typical specimen of the latter for comparison, from British Guiana, and also five good specimens from Costa Rica and Nicaragua, I feel quite certain it is different, all of the six specimens of *C. guianensis* having wholly gray upper tail-coverts and much darker flanks, the dark gray color of the breast gradually shading into the glossy black of the under tail-coverts.

The two forms are closely allied to *C. cinereiventris* Scl., of Brazil, and the three should probably be considered geographical races of one species rather than distinct species, a more exact idea of their relationship being expressed by the following nomenclature:

1. *Chætura cinereiventris* Scl. Brazil.
2. *Chætura cinereiventris guianensis* (Hartert). Guiana to Nicaragua.
3. *Chætura cinereiventris lawrencei* Ridgw. Grenada; also, Tobago, Trinidad, or Venezuela?

The three forms may be distinguished by the following characters:

a¹. Belly and flanks light gray, like breast, abruptly contrasted with glossy black of under tail-coverts.

b¹. Upper tail-coverts black, or with only inner webs edged with gray; rump, lighter gray; larger (wing 4.20–4.30). *Hab.*, Brazil......... *C. cinereiventris.*

b^2. Upper tail-coverts dark gray, with outer webs glossy blackish; rump darker gray; smaller (wing 3.85–4.20). *Hab.*, Grenada, West Indies; also, Tobago, Trinidad, or Venezuela........................*C. cinereiventris lawrencei.*

a^2. Belly and flanks blackish gray, not conspicuously different from color of under tail-coverts. Upper tail-coverts with both webs gray, like rump. *Hab.*, Guiana to Nicaragua..............................*C. cinereiventris guianensis.*

Cypseloides cherriei, sp. nov.

Sp. Char.: *Adult* (No. 127069, U. S. National Museum, Volcan de Irazú, Costa Rica; George K. Cherrie). Similar in size and general form to *C. brunneitorques* (Lafr.), but tail quite truncated, with feathers less rigid and only very minutely mucronate. Color, uniform sooty black (much darker than in *C. brunneitorques*), the under surface somewhat paler, especially anteriorly, where becoming light grayish on the chin. A large, sharply defined, spot of silky white on each side of the forehead, immediately over the lores, and a short streak of the same color immediately behind the eye; lores velvety black, in very sharp contrast with the white spot above them. Length (skin), 5 inches; wing, 6; tail, 1.87; tarsus, 0.50.

This apparently new species needs no comparison with any other, the peculiar white markings of the head being sufficient to at once distinguish it.

The type specimen was generously presented by the authorities of the Costa Rica National Museum.

NOTES ON AMERICAN HEMIPTERA HETEROPTERA.

BY

A. L. MONTANDON.*

I.

CONTRIBUTIONS TO A KNOWLEDGE OF THE SPECIES OF THE GENUS COSMOPEPLA STÅL.

This genus of the subfamily Pentatomina, as constituted by the eminent Prof. Stål: O. V. A. F., 1867, p. 525, has the following characters:

Corpore latiuscule obovato, subtus sat convexo; capite valde deflexo, thorace breviore, parviusculo, ante oculos utrimque leviter sinuato, ante sinus vix angustato, apice rotundato-truncato, jugis et tylo æque longis, marginibus sub-acutis; bucculis sat elevatis, postice altioribus; ocellis inter se quam ab oculis fere triplo longius remotis; rostro paullo pone coxas posticas extenso, articulo primo bucculas superante, articulo secundo apicalibus duobus ad unum vix breviore; antennis mediocribus, articulo primo apicem capitis æquante vel vix attingente, secundo tertio breviore; thorace anterius sat declivi, marginibus lateralibus obtusis, callosis, integris, angulis lateralibus rotundatis, haud prominulis; scutello mediocri, apice lato et rotundato, frenis ultra medium scutelli haud extensis; venis membranæ simplicibus; mesosterno leviter carinato; ostiis odoriferis paullo elevatis, in sulcum haud continuatis; tibiis teretibus, sulco destitutis.

The important characters of this long diagnosis have been summed up by M. Distant, in Biol. Cent. Amer., p. 52, as follows:

The lobes of the head are of equal length, the scutellum broad and rounded at the apex, the lateral angles of the pronotum are rounded * * * and the nervures of the membrane are longitudinal and simple.

Up to this day five species were placed in this genus, in which Stål, in his great work Enumeratio Hemipterorum, 2, 1872, pp. 18, 19, enumerated three already described species: *Cimex carnifex* Fabr., E. S., Suppl., 1798, p. 535; *Eysarcoris decoratus* Hahn, W. I., II, 1834, p. 117, Fig. 198; *Eysarcoris conspicillaris* Dallas, List of Hemipt., I, 1851, p. 225, and diagnosed *Cosmopepla cruciaria* Stål. Recently M. Distant added to these *Cosmopepla binotata* Dist., Biol. Centr.-Amer., Hemipt. Heteropt. Suppl., p. 327, Tab. XXXI, Fig. 7.

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*SIR: I have the honor to submit for publication the accompanying "Notes on North American Hemiptera Heteroptera," by Mr. A. L. Montandon, of Bucharest, Roumania. The notes are of authoritative value and Mr. Montandon has based them to a certain extent upon Museum material which I have sent over to him from time to time.

Respectfully,

C. V. RILEY,
Honorary Curator of the Department of Insects.

Mr. F. W. TRUE,
Curator-in-Charge of the U. S. National Museum.

Important material received from many parts of the American continent enables me to add two new species.

The synoptic table and the following descriptions will enable one to identify easily the seven species of the genus *Cosmopepla* known at present:

A. Scutellum very obtusely rounded at the extremity; frenum very short, not quite one-third the length the scutellum; shape of the body broadly oval.

B. Apical margin of scutellum yellowish ochraceous; abdomen beneath with a regular, narrow edge, extending to the stigmata; body above slightly and sparsely punctured.

C. Pronotum with a transverse fascia and a longitudinal central spot reaching from the anterior margin back to near the posterior margin; thorax ochraceous, shining, and impunctured, *C. cruciaria* Stål.

C. C. Pronotum with a transverse ochraceous fascia, but without the longitudinal spot; the disk of the pronotum punctured at the middle as at the sides before and behind the transverse fascia................ ....*C. cæruleata* Montand.

B. B. Apical margin of scutellum concolorous, not yellowish ochraceous, body above thickly punctured.

D. Scutellum with a red spot on each side near the apex; transverse fascia and longitudinal central spot of the pronotum narrow linear; abdomen above narrowly edged with red, *C. carnifex* Fabr.

D. D. Scutellum entirely concolorous, transverse fascia of the pronotum irregular, broadened in the middle, slightly elevated; abdomen beneath broadly edged with yellowish ochraceous; this margin inwardly sinuated opposite each stigma, *C. uhleri* Montand.

A. A. Scutellum less obtusely rounded at the extremity; frenum reaching almost one-half of the length of the scutellum; the body a little longer than that of the preceding group; above slightly brassy and thickly punctured.

E. Transverse yellowish ochraceous fascia of the pronotum irregular, slightly elevated; scutellum punctured to the apex; narrowly edged with yellow at the apex; abdomen beneath broadly edged with yellow; yellow margin deeply sinuate on each segment; stigmata black ...*C. conspicillaris* Dallas.

E. E. Transverse yellowish ochraceous fascia of the pronotum shining, regular; apex of scutellum more broadly edged with yellowish ochraceous.

F. Scutellum punctured near the apex on the yellowish ochraceous part; transverse fascia of the pronotum extended backward to near the base of the pronotum; two dark spots in the middle of the fascia; abdomen beneath with the lateral margins broadly pale ochraceous; a segmental series of small, dark, rounded spots covering the stigmata, *C. binotata* Distant.

F. F. Apex of scutellum shining, impunctate on the yellowish ochraceous part; transverse fascia of the pronotum not extended backward, impunctate, slightly elevated; abdomen beneath with pale ochraceous lateral margin of equal width including the stigmata ....*C. decorata* Hahn.

Cosmopepla cœruleata, sp. nov.

Several entomologists have given me this species with the name *C. decorata* Hahn, which is manifestly incorrect. These two species, however, are almost alike with regard to the disposition of colors, and on considering only Hahn's figure, W. I., Tab. LXV, Fig 198, one may be led to confusion. Here is the description of the author, loc. cit., II, p. 117:

Schwarz, *blaugrünlich*, glänzend, punktirt; die Seitenränder und ein breites glattes Querband über die Mitte des Rückenschildes bleichgelb, die Spitze des Schildchens gelbroth; die Ränder des obern Theils der Halbdecken schmal, die des Hinterleibes *breit* bleichgelb; Länge 3 Lin.; Breite 1¾.

Now, in the species that I describe, the color is not *blue greenish*, but polished dark blue; the abdominal yellow edge is not so broad as in Hahn's species, and the respective proportions are different; *C. cœruleata* Montand. is broader (4 to $4\frac{1}{2}$mm) proportionally to the length ($5\frac{3}{4}$ to $6\frac{1}{2}$mm).

Hahn gives Mexico as the native country of his species, and indeed I have received and studied many examples from that region (Durango; États du Centre, Dugès) which were surely *C. decorata* Hahn. But specimens of the *C. cœruleata* Montand. have been received from Venezuela (collection Fallou and my own); Costa Rica (Van Patten) (collection of National Museum, Washington, and my own); Costa Rica, Alajuela (Sec. Orozco); San José (P. Biolley), in my collection.

Notwithstanding this superficial resemblance this species deviates very much from the real *C. decorata* Hahn in the broader shape of the body, the broader scutellum at the extremity, with a shorter frenum, the more delicate and not so dense punctation, and by just these characteristics *C. cœruleata* Montand. is closely allied with *C. cruciaria* Stål, as described by the author (Enumeratio Hemipt. II, p. 19):

Cærulescente *nigra*, nitida, remote punctata, marginibus lateralibus anticis, fascia media *vittaque* percurrentibus thoracis * * * flavescentibus, *lævigatis*.

C. cruciaria Stål differs only in the longitudinal ochraceous shining line on the middle of the pronotum, which is very apparent and does not exist in *C. cœruleata* Montand., in which the disk of the pronotum is entirely punctured before and behind the transverse fascia; in the blue color of *C. cœruleata* Montand. (not dark violaceous, as *C. cruciaria* Stål), and by the relative length of the fifth joint of the antenna, which is shorter than the second and third conjointly in *C. cœruleata* Montand., whilst the fifth joint is a little longer than the second and third together in *C. cruciaria* Stål. But whether this last character is constant or not, can only be settled by an examination of a larger number of specimens.

Stål's species is mentioned by the author from Bogota, New Grenada (Mus. Holm.), and I possess in my collection two specimens from Cauca, Colombia; so that these two allied species live in the same countries and constitute the more southern forms of the genus.

Cosmopepla Uhleri sp. nov.

Castaneous, with some metallic reflection, especially on the head, and the anterior part of pronotum; above densely punctured. The lobes of the head are equal in length, the central lobe a little narrowed at the apex. Pronotum with the lateral margins and one transverse fascia ochraceous, the latter slightly elevated, with unequal callosities, sinuated before and behind, inclosing four castaneous, finely punctured spots, two on each side impressed and a fifth similar spot on the middle before the line of the four just mentioned. This fifth spot tends to disappear in the examples, in which the transverse, ochraceous fascia gives forth a central longitudinal ochraceous line extending irregularly forward, and reaching sometimes to the anterior margins of the pronotum. Scutellum broadly rounded at the apex, uniformly colored, castaneous, punctured to the extremity without any yellowish ochraceous edge. Elytra castaneous, punctured, with a somewhat shining interval to the internal angle; the exterior margin with an ochraceous callosity. Membrane of the same color as the elytra with 5 to 6 nervures. Connexivum above ochraceous, with a castaneous spot at the base of each segment, arising from the exterior margin of the elytra. Body beneath with blue greenish reflection, especially on the disk of the abdomen. Breast with small pale spots punctured with black at the base of each of the legs. Ostiolar canal ochraceous. Lateral margins of the prostethium ochraceous, with a spot of the same color on the middle of the margins. Lateral margins of the metapleura callous, ochraceous, with the posterior margins narrowly edged with ochraceous. Abdomen beneath broadly edged with ochraceous, this edge inwardly crenulated by a small extension of the color to the middle of each segment, opposite to the stigmata. The latter rather dark; the larger part of the genital segment brownish. Extremity of the femora, tibiæ broadly to the middle, and first joint of the tarsi, yellowish brown. Sometimes, however, the legs are entirely darkish.

Length, 5½ to 6mm; breadth, 3½ to 4mm. California, one example (collection Lethierry). Nevada, two examples in my collection.

It affords me special satisfaction to dedicate this species to Prof. Uhler, who thought that it constituted only a variety of *C. conspicillaris* Dall., from which it is, however, very distinct from the broader and proportionally shorter body and the more broadly rounded apex of scutellum, which is not edged with ochraceous as in specimens of the true *C. conspicillaris* Dall. The author of this last species gives this character in his diagnosis (List of the specimens of hemipterous insects in the collection of the British Museum, Part I, 1851, p. 225): "Scutellum narrowly edged with yellowish white at the apex."

C. Uhleri Montand. differs also in the brownish spots on the connexivum which is here exposed, whilst in *C. conspicillaris* Dall. the connexivum, hidden under the margin of elytra, is narrowly edged with yellowish and without spots; also in the inward crenulation of the abdominal

edge, which is produced by a small extension of the darkened abdominal disk, covering the stigmata in *C. conspicillaris* Dall., whilst the edge is crenulated with a small extension of the color of the edge opposite to the stigmata in *C. Uhleri* Montand., the edge covering the stigmata being slightly darkish in this last species.

Prof. Distant (Biol. Centr.-Amer., Tab. 5, Fig. 8), gives a very good figure of *C. conspicillaris* Dall., probably the type of the author, preserved in the British Museum. It is one of the darkest and least shining species, almost black, slightly bluish, with metallic bronze reflections. It is larger than *C. Uhleri* Montand., and measures in length 6–7^{mm}. My collection contains one example from Vancouver Island, and by the favor of Prof. C. V. Riley I have studied two specimens from Los Angeles, Cal., which are in the collection of the National Museum at Washington.

Every entomologist knows *C. carnifex* Fabr., which is widely distributed throughout the United States and British America. It does not deserve special mention.

C. binotata Distant is very well described by the author (Biol. Centr. Amer., Suppl., p. 327) and figured (Tab. 31, Fig. 7) in the same work. The color of this figure does not appear to me dark enough, but the distinguishing characters are well shown. I also have seen two specimens of this species, one from Durango, Mexico, which is in my collection, and another from Wisconsin, in the collection of Prof. Lethierry.

II.

SYNONYMICAL NOTES ON SOME NORTH AMERICAN SPECIES OF THE GENUS ALYDUS FABR.

Alydus conspersus Montandon.

=*Calcaratus* Uhler, nec Linné.

Grayish above, sparsely hairy on the head and the anterior part of the pronotum; head black, anterior margin and a longitudinal spot on the middle of the anterior part of pronotum black, the middle of this black spot sometimes with a very small longitudinal pale line. The posterior part of the pronotum and the elytra grayish with fine punctures, with castaneous and numerous irregular black spots. Membrane pale vitreous with darkish nervures and numerous round spots irregularly scattered on the surface; the greater part of the back of the abdomen red, base and extremity black. Connexivum black with a pale spot at the base of each segment. Body beneath black with metallic bronze reflections, especially on the abdomen. Antenna dark brown, with the basal two-thirds of the second, and third joints pale. Legs black, the tibiæ brownish, with the base and extremity darkish. First joint of the tarsi brownish, with the extremity black. Length, 10 to 11^{mm}.

I have received this species from Constantine, Mich.; Burlington, Iowa; Massachusetts; Colorado; and Dakota.

Of the same dimensions and color as the European species, *A. calcaratus* Lin., with which at first sight it is very easily confounded. It differs in the more sparse hairs, which are almost wanting on the disk of the pronotum; in the small, dark, rounded spots on the posterior part of the pronotum and the elytra; and especially in the whitish diaphanous membrane, with the nervures darkish and the numerous, small, rounded spots scattered on the surface. It is closely allied to the following species:

Alydus eurinus Say=*ater* Dallas.

This species is larger than *A. conspersus* (12 to 13^{mm}), darker in every way, being most frequently entirely black, with very small, pale, almost imperceptible spots at the base of the segments of the connexivum; the hair of the head and surface of the pronotum very dense and black. Some pale varieties have the elytra grayish, but the membrane is entirely infuscated and the back of the abdomen is darker than in *A. conspersus* Montand., sometimes entirely black.

It is as abundant as the preceding species, and my collection contains numerous examples from Iowa, Connecticut, Massachusetts, and Florida.

Prof. Uhler has correctly placed it in his Check List of the Hemiptera-Heteroptera of North America, 1886. Of this species Say gives the following diagnosis: "Body blackish, *hairy*, punctured; thorax densely punctured, *mutic*" (Description of New Hemipterous Insects collected in the Expedition to the Rocky Mountains, 1824). It can not be confounded, as was done by Stål (Enumerat. Hemipter., Part I, 1870, p. 213), with *A. pilosulus*, H. S., which is not of the same form, having the lateral angles of the pronotum prominently acute, as well represented in H. Schaeffer's figure 870, which gives a clear idea of this last species. Consequently the synonymy should be corrected thus:

Alydus pilosulus H. S.=*eurinus* Stål nec Say.

The small, lateral, pale edge of the pronotum renders this species easily recognizable and it is also very common. I possess specimens from St. Louis, Mo.; Florida; and Massachusetts. From the lateral acuminated angle of the pronotum this species could be placed in the subgenus Megalotomus Fieb, but it has not the long antennæ, the first joint not being longer than the second, nor the broad hollow at the base of the pronotum, as in the following species, which it approaches:

Alydus (S. G. *Megalotomus* Fieb.) *quinquespinosus* Say=*cruentus* H. S.

This last species is widely distributed throughout North America, and my collection contains specimens from Canada, Massachusetts, Wisconsin, New York, and Florida.

III.

DESCRIPTION OF TWO NEW NORTH AMERICAN SPECIES OF HETEROPTERA.

Dendrocoris pini Montandon.

Oval; pale yellow ochraceous; above coarsely and densely, beneath more finely punctured, concolorous. Head as long as broad (including the eyes), the vertex moderately convex. Antennæ brownish red, with the third joint twice as long as the second, shorter than the first and second together; joints 3, 4, and 5 equal in length. Pronotum, with a short longitudinal callus, smooth to the middle of the anterior margin, with the cicatrices of each side at the anterior part of the pronotum slightly elevated and partially smooth; the lateral margins of the pronotum straight, anterior angle very slightly notched, humeral angle obtuse, not prominent; margins of the scutellum with small, shining, and slightly elevated pale spots. Elytra with a small impunctate portion in the middle of the disk, lateral margins occasionally with pale spots like those of the margin of the scutellum. Membrane reaching the extremity of the body, concolorous, with the body and with the nervures very slightly apparent. Connexivum separated from the elytra, concolorous and densely punctured; the segmental sutures slightly elevated. Rostrum brownish red, reaching the posterior coxæ. Extremity of the femora and of the tibiæ and tarsi more or less reddish brown.

Male and female: Length, 5 to 6^{mm}; width, $3\frac{1}{2}$ to $3\frac{3}{4}$^{mm}. Found upon *Pinus monophylla* in the Argus Mountains, Cal. Collection of the U. S. National Museum and my own.

The genus *Dendrocoris* Bergroth (Revue d'Entomologie, 1891, p. 228) has been substituted for the genus *Liotropis* Uhler, preoccupied.

I am of the same opinion as Prof. Bergroth, who says that this genus should not be placed in the subfamily Asopina, in which Prof. Uhler has put it, and it evidently belongs to the subfamily Pentatomina, near the genus *Lopadusa* Stål.

The new species just described is easily distinguishable from the two which are recorded in this genus, *D. humeralis* Uhler and *D. fruticicola* Bergroth, by its smaller dimensions, the lateral obtuse angle of the pronotum not prominent, and the pale color of the body with concolorous punctures.

Sinea Rileyi Montandon.

Ferruginous brownish with a grayish pubescence, very short and not so dense upon the elytra, denser beneath, especially on the breast. Posterior and middle femora in the middle and all tibiæ in the middle paler than the body. Head a little shorter than the pronotum, with a double row of three short spines before the eyes, the anterior spines longer than the posterior, and behind the eyes on each side two

tubercles before and behind the ocelli. Neck not spinous. Anterior part of the pronotum covered with small, not very acute tubercles, more robust at the middle, the anterior part one-fourth shorter than the posterior which is granulose; disk much swollen, with a slight longitudinal impression at the middle; lateral angle slightly acuminated; posterior margin narrowly pale with two small teeth alongside the scutellum. Elytra paler at the base, the lateral margins and the small quadranglar discoidal cell near the membrane; brownish on the disk and at terminal exterior angle. Membrane pale vitreous with a brownish black spot at the interior angle, divided and continued upon the nervures and reaching to the extremity of the membrane. Abdomen much broader than the elytra (♂ and ♀), laterally margins largely rounded in the two sexes, especially ♀, with a broad pale fascia at the extremity of each segment. Abdomen beneath ferruginous, paler in the middle. Anterior femora as in all species of the genus Sinea, with sometimes whitish and very slender hairs. Superior spine at the extremity of the femora robust and pale as the spines of the inferior part. Antennæ wanting in the specimens before me.

♂ : Length $9\frac{3}{4}^{mm}$; abdominal width, $2\frac{3}{4}^{mm}$. ♀ : Length, 11^{mm}; abdominal width, 4^{mm}. Panamint Valley, California. Collection of the U. S. National Museum and my own.

I take pleasure in dedicating this species to Prof. C. V. Riley, who has sent it to me. At first sight one may identify this species by its proportionally greater breadth than in the other species of the genus; by the rounded shape of the abdomen; by the pale spots on each segment of the connexivum, by the greatly swollen pronotum posteriorly, and by the very plain brownish mark of the whitish membrane.

CATALOGUE OF THE FRESH-WATER FISHES OF CENTRAL AMERICA AND SOUTHERN MEXICO.

BY

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In this paper I have endeavored to complete the enumeration of the tropical American fresh-water fishes. The species inhabiting this region should have been enumerated with the South American species* with which they are closely related. The list was omitted because several works bearing on these fishes could not be examined before the South American catalogue went to press.

The region covered by this catalogue embraces the fresh waters north of the Isthmus of Panama to the Tropic of Cancer.

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*Proc. U. S. Nat. Mus., 1891, pp. 1–81. Since this paper was published a number of new species have been described. I take this occasion to add these and also to give a number of species overlooked in the former paper.

Bunocephalus iheringii Boulenger. Proc. Zoöl. Soc., 1891, 235.

Pseudopimelodus cottoides Boulenger. Proc. Zoöl. Soc., 1891, 233. (Closely allied to *P. parahybæ* Steindachner.)

Pimelodella eigenmanni Boulenger=*P. buckleyi* E. & E., not Boulenger.

Pimelodus nigribarbis Boulenger. Proc. Zoöl. Soc., 1891, 232. Distinct from *P. valenciennis* Luetken.

Pimelodus argenteus Perugia. Ann. Mus. Genov. (2) x, 631, 1892. Plate, R. Parana.

Pimelodus spegazzinii Perugia. Loc. cit. 632. Durango.

Pygidium minutum (Boulenger). Proc. Zoöl. soc., 1891, 235.

Acanthopoma annectens Luetken. Vidensk. Medd., 1892. (Near *Stegophilus*.)

Otocinclus nigricauda Boulenger. Proc. Zoöl. Soc., 1891, 234.

Chætostomus aculeatus Perugia. Ann. Mus. Genov. (2) x, 677, 1882. Paraguay.

Loricaria cadeæ Hensel=*L. lima* Kner.

Loricaria evansii Boulenger. Jaganda, Matto Grosso, Brazil. Ann. and Mag. Nat. Hist. July, 1892.

Elopomorphus trilineatus?

Elopomorphus orinocensis Steindachner. Orinoco. Ichthyol. Beiträge, XIX, 1888.

Plethodectes erythrinus Cope. *Chalceus erythrurus* Cope.

Tetragonopterus steindachneri sp. nov. Iquitos. Loc. cit., XV, July 26, 1892. The name *lineatus* is preoccupied by *T. lineatus* Perugia. April, 1892.

Tetragonopterus anomalus Steindachner. Corrientes. Loc. cit., 27.

Tetragonopterus nigripinnis Perugia. Ann. Mus. Genov. (2) x, 643, April, 1892.

Tetragonopterus lineatus Perugia. Loc. cit., 644.

Tetragonopterus moorii Boulenger. Chapala Platas, Matto Grosso. Ann. and Mag. Nat. Hist., July, 1892.

PETROMYZONTIDÆ.

LAMPETRA Gray.

Lampetra spadicea Bean. Guanajuato, Mexico. Proc. U. S. Nat. Mus., 1887, 374, Pl. xx, Fig. 6.

GALEORHINIDÆ.

EULAMIA Gill.

Eulamia nicaraguensis Gill Rio San Juan. Proc. Acad. Nat. Sci. Phila., 1877.

LEPIDOSTEIDÆ.

LEPIDOSTEUS Lacépède.

Lepidosteus tropicus Gill. Mexico, Guatemala. Proc. Acad. Nat. Sci. Phila., 1863, 172.

SILURIDÆ.

AMIURUS Rafinesque.

Amiurus dugèsii Bean. Rio Turbio, Guanajuato, Mexico. Proc. U. S. Nat. Mus., 1879, 304.

ICTALURUS Rafinesque.

Ictalurus meridionalis (Guenther). Rio Usumacinto, Guatemala. Cat. Fish. Brit. Mus., v, 102, 1864.

RHAMDELLA Eigenmann and Eigenmann.

Rhamdella parryi E. & E.—Rio Zanaleneo near Tonala, Chiapas, Mexico. Proc. Cal. Acad. Sci., 2d ser. 1, 130.

Rhamdella petenensis (Guenther) Lake Peten, Chiapas, Mexico. Cat. Fish. Brit. Mus., v, 126.

Rhamdella brachyptera (Cope). Mexico. Trans. Am. Philos. Soc., XIII, 404.

Brachychalcinus retrospina Boulenger. Santa Cruz, Matto Grosso. Loc. cit., 12. "Intermediate between *Tetragonopterus* Cuv. and *Luetkenia* Stdr. * * * Differing from both in having a movable spine, directed forwards, in front of the dorsal fin.

Pseudocorynopoma doriæ Perugia. Arroyo Miguelete. Ann. Mus. Genova (2), x, 1891, 646, fig. (April.) *Bergia altipinnis* Steindachner. (July, 1891.)

Piabuca malanostoma Holmberg. Argentina. Bol. Ac. Cordóba, 1887.

Xiphorhamphus jenynsii Guenther. This is said to be a good species.

Xiphophorus heckeli Weyenberg. Primero River. Versl. Ak. Amst. (2) VIII, 291, 18—.

Haplochilus balzanii Perugia. 653.

Orestias bairdi Cope. Titicaca. J. Acad. Phila., 1876.

Orestias ortoni Cope. Titicaca. Loc. cit.

Orestias frontosus Cope. Titicaca. Loc. cit.

Rhodeoides vaillanti Thominot. Bolivia, Magdalena. Bull. Soc. Philom. (7), VIII, 150, 1884.

Percichthys vinciguerræ Perugia. Loc. cit., 610.

Crenicichla punctata et polysticta Hensel=*C. lacustris* (Castelnau).

Geophagus balzanii Perugia, 632. Prio Paraguay, Matto Grosso.

Geophagus rhabdotus, bucephalus, labiatus, scymnophilus, et pygmæus Hensel.=*G. brasiliensis* Quoy and Gaimard.

I wish to acknowledge my indebtedness to Dr. von Ihering, of Rio Grande Do Sul, for suggesting many of the above corrections.

Rhamdella baronis mülleri (Troschel). Pacific coast of Mexico. Mueller, Wierbelth, Mexico, 1865, 102.
Rhamdella guatemalensis (Guenther). Huamuchal, Guatemala, Nicaragua. Cat. Fish. Brit. Mus., v, 122.
Rhamdella salvini (Guenther). Rio San Geranimo, Guatemala. Loc. cit., 130.
Rhamdella policaulus (Guenther). Rio San Geranimo. Loc. cit., 131.
Rhamdella managuensis (Guenther). Lake Managua. Guenther, Fishes Central America, 393 and 476, 1866.
Rhamdella hypselurus (Guenther). Mexico. Cat. Fish. Brit. Mus., v, 126.
Rhamdella motaguensis (Guenther). Rio Motagua. Loc. cit., 127.
Rhamdella laticauda (Heckel). Mexico. Loc. cit., 127.
Rhamdella nicaraguensis (Guenther). Lake Nicaragua. Loc. cit., 125.
Rhamdella micropterus (Guenther). Rio San Geronimo. Loc. cit., 124.
Rhamdella godmani (Guenther). Lower Vera Paz, Mexico. Loc. cit., 124.

CATOSTOMIDÆ.

ICTIOBUS Rafinesque.

Ictiobus meridionalis (Guenther). Rio Usumacinta. Guenther, Fishes Central America, 486, 1866.

MOXOSTOMA Rafinesque.

Moxostoma austrina Bean. Guanajuato. Proc. U. S. Nat. Mus., 1878, 302.

CYPRINIDÆ.

ALGANSEA Girard.

Algansea australe Jordan.* Lake Tupataro, Guanajuato, Mexico. Proc. U. S. Nat. Mus., 1879, 300.

NOTROPIS Rafinesque.

Nctropis altus Jordan. Lake Tupataeo, Guanajuato, Mexico. Loc. cit., 301.
Notropis sallæi Guenther. Cuernavaca, Mexico. Cat. Fish. Brit. Mus., v, II, 484.
Notropis nigrotæniatus Guenther. Altisco, Mexico. Loc. cit., 485.

CHARACINIDÆ.

TETRAGONOPTERUS Cuvier.

Tetragonopterus fasciatus Cuvier. Mexico, Guatemala, Rio Chisoy, Vera Paz, Rio Guacalate, Rio San Juan outlet of Lake Nicaragua.
Tetragonopterus microphthalmus Guenther. Pacific coast of Guatemala. Cat. Fish. Brit. Mus., v. 324.
Tetragonopterus panamensis Guenther. Guatemala; Panama. Loc. cit., 324.
Tetragonopterus brevimanus Guenther. Yzabal and Rio San Geranimo. Guatemala. Loc. cit., 324.
Tetragonopterus petenensis Guenther. Lake Peten. Loc. cit., 326.
Tetragonopterus ..neus Guenther. Rio Frijoli; Oaxaca, Mexico. Loc. cit., 326.
Tetragonopterus humilis Guenther. Lake Amatitlan, Guatemala. Loc. cit., 327.
Tetragonopterus mexicanus Filippi, Lake Mexico, Izucar. Steind., Ichth. Not., IX, 1869, 11.
Tetragonopterus scabripinnis Jenyns. Xamapa, Mexico. Guenther, Cat. Fish. Brit. Mus., v, 325.
Tetragonopterus belizianus Bocourt. Belize. Bocourt in Ann. Sc. Nat., 1868, IX, 62.

Tetragonopterus cobanensis Bocourt. Rivers of Coban. Loc. cit., 62.
Tetragonopterus finitimus Bocourt. Orizaba. Loc. cit., 62.
Tetragonopterus fulgens Bocourt. Province of Cuernavaca. Loc. cit., 62.
Tetragonopterus nitidus Bocourt. De Tasco. Loc. cit., 62.
Tetragonopterus oaxacanensis Bocourt. Oaxaca. Loc. cit., 62.
Tetragonopterus argentatus Baird and Girard. Arkansas to Mexico.

BRYCON Müller and Troschel.

CHALCINOPSIS Kner.

Brycon dentex Guenther. Lake Nicaragua, Rio Motagua, Rio Usumacinto, Yzabal. Cat. Fish. Brit. Mus., v, 337.

RŒSTES Guenther.

Rœstes guatemalensis (Guenther). Huamuchal, Lake Nicaragua. Cat. Fish. Brit. Mus., v, 347.

BRAMOCHARAX Gill.

Bramocharax bransfordi Gill. Lake Nicaragua. Proc. Acad. Sci. Philad., 1877, 187.

DOROSOMIDÆ.

DOROSOMA Rafinesque.

Dorosoma petenensis Guenther. Lake Peten. Cat. Fish. Brit. Mus., VII, 408.

CYPRINODONTIDÆ.

CHARACODON Guenther.

Characodon ferrugineus Bean. Guanajuato, Mexico. Proc. U. S. Nat. Mus., 1887, 372.
Characodon variatus Bean. Guanajuato, Mexico. Loc. cit., 370.
Characodon lateralis Guenther. Central America. Cat. Fish. Brit. Mus., vi, 308.
Characodon bilineatus Bean. Guanajuato. Proc. U. S. Nat. Mus., 1887, 370.
Characodon furcidens Jordan and Gilbert. Streams tributary to the Gulf of California and southward. Proc. U. S. Nat. Mus., 1882, 354.
Characodon atripinnis Jordan. Guanajuato. Proc. U. S. Nat. Mus., 1879, 354.

GIRARDINICHTHYS Bleeker.

Girardinichthys innominatus Bleeker. Near City of Mexico. Günther, Cat. Fish. Brit. Mus., VI, 309.

ZYGONECTES Agassiz.

Zygonectes dovii Guenther. Punta Arena, Costa Rica. Cat. Fish. Brit. Mus., vi, 316.

FUNDULUS Lacépède.

Fundulus labialis Guenther. Rio San Geronimo, Yzabel, Guatemala. Loc. cit., 319.
Fundulus punctatus Guenther. Chiapam. Loc. cit., 320.
Fundulus guatemalensis Guenther. Lakes Dueñas and Amatitlan, Rio Guacalate, (Western Ecuador). Loc. cit., 321.
Fundulus pachycephalus Guenther. Lake Atitlan, Guatemala. Loc. cit., 322.
Fundulus dugèsi Bean. Guanajuato, Mexico. Proc. U. S. Nat. Mus., 1887, 373, Pl. XX, Fig. 5.

PSEUDOXIPHOPHORUS Bleeker.

Pseudoxiphophorus bimaculatus Heckel. Cordova, Mexico, Guenther, Cat. Fish. Brit. Mus., VI, 332. *Pœciliodus bimaculatus* Steindachner.

Pseudoxiphophorus reticulatus Troschel. Mexico. Guenther, Cat. Fish. Brit. Mus., VI, 333.

BELONESOX Kner.

Belonesox belizanus Kner. Lake Peten, Honduras, Guatemala, Mexico. Guenther, Cat. Fish. Brit. Mus., VI, 333.

GAMBUSIA Poey.

Gambusia episcopi Steindachner. Obispo. Ichthyol. Beitr., VI, 11, 1878.

Gambusia nicaraguensis Guenther. Lake Nicaragua. Guenther, Cat. Fish. Brit. Mus., VI, 336.

Gambusia gracilis Heckel. Orizaba, Mexico. Guenther. Cat. Fish. Brit. Mus., VI, 336.

ANABLEPS Linnæus.

Anableps dowei Gill. Chiapam, Guatemala. Guenther, Cat. Fish. Brit. Mus., VI, 338.

PŒCILIA Bloch and Schneider.

Pœcilia mexicana Steindachner. Chiapam, Rio Chisoy, Vera Paz, Lake Amatitlan. Guenther, Cat. Fish. Brit. Mus., V, 341.

Pœcilia thermalis Steindachner. San Salvador, warm springs. Günther, loc. cit., 341. *P. modesta* Troschel.

Pœcilia chisoyensis Guenther. River Chisoy, Vera Paz. Cat. Fish. Brit. Mus., V, 342.

Pœcilia petenensis Guenther. Lake Peten. Loc cit., 342.

Pœcilia sphenops Cuvier & Valenciennes. Mexico, Vera Cruz. Guenther, Cat. Fish., Brit. Mus., VI, 343.

Pœcilia dovii Guenther. Lake Nicaragua, Mexico. Loc. cit., 344. ? *G. plumbea* Troschel.

Pœcilia spilurus Guenther. Central America. Loc. cit., 345.

?**Pœcilia couchii** Girard. Rio San Juan, Province New Leon. Loc. cit., 346.

Pœcilia fasciata (Müller & Troschel). Mexico. Guenther. Loc. cit., 339.

Pœcilia butleri Jordan. Mazatlan. Proc. U. S. Nat. Mus., 1883, 330.

MOLLIENESIA Lesueur.

Mollienesia petenensis Guenther. Lake Peten. Guenther, Cat. Fish. Brit. Mus., VI, 348.

Mollienesia formosa Girard. Palo Alto, Mexico. Guenther. Loc. cit., VI, 349.

Mollienesia jonesi Guenther. Huamantla, Mexico. Ann. and Mag. Nat. Hist., XIV, 370, 1874.

XIPHOPHORUS Heckel.

Xiphophorus kelleri Heckel. River Chisoy, Cordova, Mexico. Guenther, Cat. Fish. Brit. Mus., VI, 345.

PLATYPŒCILIUS Guenther.

Platypœcilius maculatus Guenther. Mexico. Loc. cit., 350.

GIRARDINUS Poey.

Girardinus pleurospilus Guenther. Lake Duenas, Guatemala. Loc. cit., 353.
? **Girardinus occidentalis** Baird & Girard. Rio Santa Cruz, Mexico, Loc. cit., 354.

MUGILIDÆ.

AGONOSTOMUS Bennett.

Agonostomus nasutus Guenther. Rio San Geronimo. Loc. cit., 463. *Dajaus elongatus* Kner & Steindachner.
Agonostomus monticola (Bancroft). Mexico (West Indies). Loc. cit., 464.
Agonostomus globiceps Guenther. Vera Cruz. Guenther, Ann. and Mag. Nat. Hist. (4), XIV, 370.
Agonostomus microps Guenther. Rio Guacalata. Cat. Fish. Brit. Mus., III, 462.

ATHERINIDÆ.

CHIROSTOMA Swainson.

Chirostoma humboldtiana (Cuvier & Valenciennes). Mexico. Guenther, Cat. Fish. Brit. Mus., III, 404. *A. vomerina*, C. & V.
Chirostoma brasiliensis Quoy & Gaimard. Mexico. Proc. U. S. Nat. Mus., 1879, 299.
Chirostoma estor Jordan. Lake Chapala, Mexico. Loc. cit., 1870, 298.

CICHLIDÆ.

ASTRONOTUS Swainson.

THERAPS.

Astronotus irregularis Guenther. Guatemala. Cat. Fish. Brit. Mus., IV, 284.

ASTRONOTUS.

Astronotus rectangularis Steindachner. Mexico. Steind., Chromiden Mejicos.
Astronotus bifasciatus Steindachner. Mexico. Loc. cit., 4.
Astronotus lentiginosus Steindachner. Mexico. Loc. cit., 6.
Astronotus maculipinnis Steindachner. Xamapa River. Loc. cit., 13.
Astronotus gibbiceps Steindachner. Teapa River, Mexico. Loc. cit., 12.
Astronotus rostratus Gill & Bransford. Lake Nicaragua. Proc. Acad. Nat. Sci., Philad., 1877, 181.
Astronotus balteatus Gill & Bransford. Lake Nicaragua. Loc. cit., 184.
Astronotus centrarchus Gill & Bransford. Lake Nicaragua. Loc. cit., 185.
Astronotus basilaris Gill & Bransford. Rio San Juan. Loc. cit., 182.
Astronotus beani Jordan. Mazatlan. Proc. U. S. Nat. Mus., 1888, 332.
Astronotus pavonaceus Garman. Monclava, Coahuila. Bull. Mus. Comp. Zoöl., 1881, 93.
Astronotus cœruleopunctatus Kner & Steindachner. Rio Chagres (Western Slope Andes). Bair. Ak. Wiss., 1864. 16. Pl., Fig. 3.
Astronotus parma Guenther. Xamapa River, Mexico. Cat. Fish. Brit. Mus., IV, 285.
Astronotus fenestratus Guenther. Xamapa River, Mexico. Loc. cit., 285.
Astronotus margaritifer Guenther. Lake Peten, Mamomi. Loc. cit., 287.
Astronotus melanopogon Steindachner. Central Am. Steind., Chromiden Mejicos, 16.
Astronotus melanurus Guenther. Lake Peten. Cat. Fish. Brit. Mus., IV, 288

Astronotus macracanthus Guenther. Chiapam & Huamuchal. G. Fish Central America, 451.

Astronotus spilurus Guenther. Rio Motagua, Guatemala. Cat. Fish. Brit. Mus., IV, 289.

Astronotus cyanoguttatus Baird & Girard. Texas, Mexico. Guenther. Loc. cit. 290.

Astronotus nigrofasciatus Guenther. Atitlan and Amatitlan. Fishes Central America, 452.

Astronotus multispinosus Guenther. Lake Managua. Loc. cit., 453.

Astronotus longimanus Guenther. Lake Nicaragua. Loc. cit., 454.

Astronotus helleri Steindachner. Teapa River, Tabasco, Mexico. Steind., Chromiden Mejicos, 8.

Astronotus urophthalmus Guenther. Lake Peten. Cat. Fish. Brit. Mus., IV, 291.

Astronotus troscheli Steindachner. Mexico. Ichthyol., IV, 12.

Astronotus aureus Guenther. Mexico, Guatemala, Rio San Juan, Rio Motagua, Yzabal. Cat. Fish. Brit. Mus., IV, 292.

Astronotus affinis Guenther. Lake Peten. Loc. cit., 292.

Astronotus labiatus Guenther. Managua. Fish. Central America, 455.

Astronotus erythræus Guenther. Managua. Loc. cit., 457.

Astronotus lobochilus Guenther. Managua. Loc. cit., 457.

Astronotus citrinellus Guenther. Nicaragua. Loc. cit., 459.

Astronotus altifrons Kner & Steindachner. Western Veragua. Guenther, fishes of Central America, 459.

Astronotus friedrichthalii Heckel. Lake Peten, Rio San Juan. Guenther, Cat. Fish. Brit. Mus. iv., 294.

Astronotus salvini Guenther. Lake Peten, Yzabal. Loc. cit., 294. *Heros trigramma*, Steindachner.

Astronotus trimaculatus Guenther. Chiapam, Huamuchal. Fishes of Central America, 461.

Astronotus dovii Guenther. Lake Nicaragua. Loc. cit., 461.

Astronotus motaguensis Guenther. Motagua. Loc. cit., 462.

Astronotus managuensis Guenther. Managua. Loc. cit., 463.

Astronotus microphthalmus Guenther. Rio Motagua. Cat. Fish. Brit. Mus., iv., 295.

Astronotus oblongus (Guenther). Rio Motagua; Fishes of Central America, 464.

Astronotus nicaraguensis Guenther. Nicaragua. Loc. cit., 465.

Astronotus deppii Heckel. Mexico; G. Cat. Fish. Brit. Mus., iv., 296.

Astronotus montezuma Heckel. Mexico; G. Loc. cit., 296.

Astronotus godmanni Guenther. Cahabon River, Guatemala. G. Loc. cit., 297.

Astronotus nebulifer Guenther. Mexico. Loc. cit., 297.

Astronotus sieboldi Kner & Steindachner. New Granada; G. Fish. Central America, 466.

Astronotus irregularis Guenther. Rivers Chisoy, San Geranimo, and Santa Isabel, Loc. cit., 467.

Astronotus intermedius Guenther. Lake Peten; G. Cat. Fish. Brit. Mus., iv., 298.

Astronatus angulifer Guenther. Santa Isabel River. Loc. cit., 298.

PETENIA.

Astronotus splendida Guenther. Lake Peten. Loc. cit., 301. *Heros insidiator* Heckel.

NEETROPLUS Guenther.

Neetroplus nicaraguensis Gill & Bransford. Lake Nicaragua. Proc. Acad. Nat. Sci. Philad., 1877. 186.

Neetroplus nematopus Guenther. Managua; Fish. Central America, 470.

GOBIIDÆ.

GOBIOMORUS Lacépède.

Gobiomorus lateralis Gill. Rio Presidia, Mazatlan, Panama. Guenther, Cat. Fish. Brit. Mus., III, 122.

Gobiomorus dormitator Lacépède. Mexico, Lake Nicaragua. Guenther, loc. cit., 119. *G. longiceps* Guenther.

DORMITATOR Gill.

Dormitator maculatus (Bloch.) Anamahal, Cordova. Guenther, loc. cit., 557.

ELEOTRIS Bloch and Schneider.

Eleotris pisonis (Gmelin). Rio Bayano. Guenther, loc. cit., 122.

Eleotris æquidens (Jordan & Gilbert). Mazatlan, Colima. Proc. U. S. Nat. Mus., 1881, 461.

SICYOPTERUS Gill.

Sicyopterus gymnogaster Grant. Mazatlan. Proc. Zoöl. Soc. Lond., 1884, 158.

CHONOPHORUS Poey.

Chonophorus taiasica (Lichtenstein). Both Coasts of Mexico, entering rivers. Guenther, Cat. Fish. Brit. Mus., III, 59, as *Gobius banana*.

Chonophorus mexicanus (Guenther). Eastern slope of Mexico. Loc. cit., 61.

GOBIOIDES Lacépède.

Gobioides broussoneti (Lacépède). Mexico. Steindachner, Zur Fischfauna des Cauca, etc., 43, 1879.

The following marine species have also been found in fresh water:*

Tachisurus jordani Eignenmann & Eigenmann. Rio Presidio, Mazatlan.
Tachisurus guatemalensis (Guenther). Rio Presidio.
Tachisurus cœrulescens (Guenther). Rio Presidio.
Centropomus robalito Jordan & Gilbert. Rio Presidio.
Bairdiella icistia (Jordan & Gilbert). Rio Presidio.
Gerres peruvianus Cuv. & Val. Rio Presidio.
Gerres lineatus (Humboldt). Rio Presidio.

BLOOMINGTON, IND., *September* 19, 1892.

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* See Proc. U. S. Nat. Mus., 1888, 329.

NOTE.—Dr. Theo. Gill has kindly called my attention to the following paper and list of new species: Holmberg, F. L. Sobre algunos Peces nuevos o poco conocidos de la Republica Argentina *in* Rev. Arg. Hist. Nat., I, 180–193, 1891.

Acharnes niederleinii, p. 181, [Acharnes (Müll.) is a mere synonym of Cichla.—T. Gill]; A. chacoensis, p. 182; Heros centralis, p. 183; Curimatus nitens, p. 184; C. conspersus, p. 185; Prochiledus platensis, p. 186; Leporinus solarii, p. 187; Tetragonopterus correntinus, p. 188; T. erythropterus, p. 189; Chalcinopelecus (n. g.) argentinus, p. 191; Piabuca melanëstoma, p. 192; Myletes (Myleus) mesopotamicus, p. 193.

ON THE MAKING OF GELATIN CASTS.

BY

J. W. SCOLLICK, *Preparator.*

In undertaking the preparation of a series of the various breeds of domestic fowls for the U. S. National Museum, it was necessary at the outset to solve the problem of replacing the natural combs by artificial ones since the natural combs when dried are so much distorted from shrinkage as to seriously detract from the appearance of the mounted specimens.

Since no modeling, however skillful, can give the exact appearance and pattern of the papillæ with which the comb of a fowl is covered, it seemed desirable that the artificial comb should be cast in a mold made from the natural one. For the cast itself some durable material was needed that could be readily worked and easily colored, and was capable of resisting changes of temperature.

While wax possesses the first two qualifications, and is, from its translucent character, very effective for combs and wattles, yet cold renders it brittle and the heat of a Washington summer causes it to soften and lose shape. It is, therefore, unsuitable for the purpose.

Preparations with glue (or gelatin) for their basis having been used successfully for anatomical models, cast of fishes, etc., it seemed probable that this substance could be employed with advantage for artificial combs. After considerable experimenting the following combination was found to give good results:

	Ounces.
Best Irish glue	4
Gelatin*	2
Glycerin	4
Boiled linseed oil	¼

The glue and gelatin should be softened in 60 per cent alcohol, only enough being used to barely cover them. The object of this is to introduce as little water as possible into the compound.†

The glue should then be melted and the glycerin stirred into it, together with a few drops of carbolic acid or oil of cloves.

Casts made of the above material have lain exposed to the sun for

*A strong gelatin such as is used by photographers is best.

†Other methods may be followed, however, such as wetting the glue and wrapping it in a moist cloth.

an entire summer and been kept in a warm, dry room for the rest of the year without shrinkage or other change of form.

Owing to the small proportion of water, this compound is so dense and dries so rapidly that it is with difficulty poured into a mold, and in making casts of combs it is best to warm the mold, fill each half with the melted mixture, and press the halves firmly together.

The comb of a fowl is, of course, cut off before being molded. The artificial comb is attached by applying a coat of the gelatin compound to the cranium, warming the base of the comb with a hot modeling tool, and immediately pressing the comb in place.

Mold marks and other imperfections are to be removed by trimming with sharp scissors and running over the places with a warm iron modeling tool, but some little practice is needed in order to do this well.

By slight modifications in the proportions of glue and water and by varying the method of manipulation, casts may be made of a great variety of objects, and the compound is, of course, equally available for gelatin molds.

It must be borne in mind that the addition of more water, while increasing the fluidity of the melted mass, also increases the amount of shrinkage of the cast, since, sooner or later, the water must dry out; still, in most instances, a small amount of shrinkage is of little consequence.

Another method of making a cast is to fill the mold with small pieces of the compound which have been melted and dried, place the mold in a steam oven with a vessel containing a little water, and subject it to a continuous heat. The moisture produced by the evaporating water furthers the melting of the glue, and can be driven off by exposure to dry heat. The objection to this method is the rapid deterioration of a plaster mold under long-continued heating, but where only one cast or a few are to be made this is of no consequence.

While this is the best method of heating a mold and keeping it warm, it can be done successfully by using a deep, open pan containing 2 or 3 inches of sand.

In making large casts, or even those of moderate size, a wooden block or core may be used not only as a matter of economy, but to permit the more rapid drying of the mass, to lessen the chance of shrinkage, and to give a firm base for the attachment of supports. Thin casts, like the wattles of a fowl, may be strengthened with wire cloth or with bolting cloth.

A ground color may be given to gelatin casts by the use of dry or tube colors, but in either case the coloring matter should be thoroughly mixed with the glycerin before this is added to the melted glue.

Molds should be shellacked and oiled before using, as in making plaster casts, and it may be said that an oatmeal pot of the glazed ironware, known as "graniteware," makes an excellent gluepot.

CATALOGUE OF THE CRABS OF THE FAMILY MAIIDÆ IN THE U. S. NATIONAL MUSEUM.

BY

MARY J. RATHBUN,

Department of Marine Invertebrates.

(With Plates, III–VIII.)

In the following catalogue the same general plan has been followed as in the author's "Catalogue of Periceridæ" published in the Proceedings of the Museum for 1892, No. 901. Of the 34 known genera, but 19 are represented in the collection and by 39 species only. This includes one new genus and 5 new species described below. Of the 39 species, 6 are European; 17 are North American, of which 7 are found only on the east coast, and 8 on the west coast, while 2 extend by the way of the Arctic Ocean from the Atlantic to the Pacific; 1 species is from the east coast of South America, 2 are confined to Japan, while 13 are found in various localities throughout the Indo-Pacific. At the close of the catalogue a list of 100 species and varieties not in the collection is given in the hope that they may be obtained in the future through gifts and exchange.

In an appendix are added descriptions by Dr. William Stimpson of Maiidæ collected by the North Pacific Exploring Expedition. Illustrations of 2 species not hitherto figured are published, the original drawings having been enlarged by Mr. A. H. Baldwin, who furnished also the other drawings for this catalogue.

MAIIDÆ.

Maioid brachyurans with eyes retractile in distinctly defined orbits which are often more or less incomplete below or marked with open fissures in their upper and lower margins. Basal antennal joint always more or less enlarged.

KEY TO SUBFAMILIES.

A′ Carapace usually subtriangular. Rostrum well developed. Anterior legs in male usually enlarged; fingers not excavate at tips .... *Maiinæ*

A″ Carapace broadly triangular or oval or nearly circular. Rostrum very short or obsolete. Anterior legs in male small, slender; fingers usually excavate at tips .... *Schizophrysinæ*

A''' Carapace suboblong. Rostrum vertically or nearly vertically deflexed, usually broad, lamellate. Fingers acute at tips. Basal antennal joint very much enlarged. Eye peduncles long, geniculated, and laterally projecting.. *Micippinæ*

KEY TO GENERA.

Maiinæ.

A' Rostrum vertically compressed and bifid or notched at the extremity. Orbits shallow and very open above; eyes when retracted visible from above; eye peduncles short and thick.
  B' Ambulatory legs extremely long and slender.
    C' (Orbits with two fissures above and below)............................ *Egeria*
    C'' (Orbits with one fissure above and below)...................... *Chorilibinia*
  B'' Ambulatory legs of moderate length.
    C' Ambulatory legs with the merus joints dilated in winglike expansions.. *Hemus*
    C'' Ambulatory legs compressed and flattened..................... *Chionœcetes*
    C''' Ambulatory legs subcylindrical.
      D' Second joint of antenna dilated.. *Hyas*
      D'' Second joint of antenna slender, subcylindrical.
        E' Rostrum with lateral margins involuted .... *Cœlocerus*
        E'' Rostrum with lateral margins not involuted.................. *Herbstia*
A'' Rostrum composed of two more or less distinct divergent spines. Orbits deep; eyes when retracted, concealed; eyes small; eye peduncles slender.
  B' Orbits large, directed forward, usually very incomplete below; upper margin usually prominent, with two deep fissures and long spines.
    C' Flagellum of antenna arising within the orbital cavity.. .... *Maia*
    C'' Flagellum of antenna arising within the orbital margin, and separated from the cavity of the orbit by a narrow process of the basal joint.
      D' Carapace pyriform.
        E' (Rostral spines short).. *Phycodes**
        E'' (Rostral spines long)... *Oplopisa*
      D'' Carapace subtriangular.
        E' Merus joint of outer maxillipeds notched for the insertion of the next joint.
          F' Ambulatory legs spinose .... *Chlorinoides*
          F'' Ambulatory legs unarmed................................. *Paramithrax*
        E'' (Merus joint of outer maxillipeds with anterior margin entire) *Acanthophrys*
  B'' Orbits small, directed outward. Orbital margin not prominent, with one or two hiatuses above and one below.
    C' First ambulatory legs very long.
      D' Spines of rostrum with an accessory spinule near the extremity...... *Naxia*
      D'' Spines of rostrum without an accessory spinule.
        E' Basal antennal joint narrow, with or without a spine at the antero-external angle .... *Hyastenus*
        E'' (Basal antennal joint dilated and unarmed externally, unidentate posteriorly and in the middle) .... *Lepidonaxia*
    C'' First ambulatory legs of moderate length.
      D' Præocular spine present.
        E' Rostral spines parallel or in contact to near their extremities .... *Pisa*
        E'' Rostral spines divergent.
          F' Chelipeds much smaller than the ambulatory legs .... *Lepteces*
          F'' Chelipeds as large as the ambulatory legs
            G' Ambulatory legs armed with spines .... *Nibilia*
            G'' Ambulatory legs unarmed.

*There is some doubt as to the proper position of this genus.

H′ Second and third joints of antennæ dilated .... *Scyra*
H″ Second and third joints of antennæ not dilated.
K′ (Palms elongated) .... *Notolopas*
K″ (Palms robust) .... *Rochinia*
D″ Præocular spine absent.
E′ Basal antennal joint elongated, its distal portion visible from above. *Pelia*
E″ Basal antennal joint with its distal portion not visible from above.
F′ (Spines of rostrum subparallel) .... *Pisoides*
F″ Spines of rostrum laminate at base, slightly divergent ...... *Eurynome*
F‴ (Spines of rostrum deflexed) .... *Micippoides*

Schizophrysinæ.*

A′ (Fingers acute at tips) .... *Temnonotus*
A″ Fingers excavate at tips.
B′ Spines of rostrum with one or more accessory spines .... *Schizophrys*
B″ (Spines of rostrum simple) .... *Cyclax*

Micippinæ.

A′ Orbits very incomplete, defined above, open below.
B′ Orbits tubular.
C′ (Præocular spines small) .... *Criocarcinus*
C″ (Præocular spines much enlarged) .... *Picroceros*
B″ Orbits not tubular .... *Pseudomicippa*
A″ Orbits narrowly oval, well defined .... *Micippa*
A‴ (Orbits scarcely defined either above or below) .... *Paramicippa*

KEY TO SPECIES EXAMINED.

Hemus.

Ambulatory legs with the merus joints dilated in winglike expansions ... *cristulipes*

Hyas.

A′ Carapace subtriangular; hepatic region not dilated laterally. Basal antennal joint subtriangular .... *araneus*
A″ Carapace lyrate; hepatic region dilated laterally. Basal antennal joint with sides nearly parallel.
B′ Posterior angle of hepatic projection rounded. Basal antennal joint without a large tubercle at the antero-external angle .... *coarctatus*
B″ Posterior angle of hepatic projection subacute. Basal antennal joint with a large tubercle at the antero-external angle .... *lyratus*

Chionœcetes.

A′ Carapace tuberculose; branchial regions flattened .... *opilio*
A″ Carapace spinose; branchial regions dilated .... *tanneri*

Herbstia.

A′ Inferior orbital margin not toothed. Legs not spinose .... *condyliata*
A″ Inferior orbital margin toothed. Legs spinose .... (*Herbstiella*) *camptacantha*

*The genus *Pleurophricus*, A. Milne Edwards, which Miers places in this division of the Maiidæ, is classed by Ortmann among the Corystoidea.

Cœlocerus.

Carapace with six median spines...*grandis*

Maia.

A′ Carapace spinose above. Chelipeds in male enlarged....................*squinado*
A″ Carapace tuberculose above. Chelipeds slender..........................*verrucosa*

Paramithrax.

A′ Chelipeds in male enlarged; hand compressed; carpus with two longitudinal ridges, the outer usually oblique ....Subgenus *Paramithrax*
B′ Carpus with inner ridge smooth..*peronii*
B″ Carpus with ridges spinulose...*edwardsii*
B‴ Carpus with inner ridge cut into lobes ....*latreillei*
B⁗ Carpus, including ridges, granulose ....*sternocostulatus*
A″ Chelipeds in male elongated; hand and carpus subcylindrical; carpus not ridged ....Subgenus *Leptomithrax*
B′ Carapace, merus, and carpus spinulose...*australis*
B″ Carapace, merus, and carpus covered with flattened tubercles......*longimanus*

Chlorinoides.

A′ Rostral horns bifurcate ....*spatulifer*
A″ Rostral horns not bifurcate...*longispinus*

Pisa.

A′ Chelipeds in male with palms dilated; fingers arched, and meeting only at the ends...*tetraodon*
A″ Chelipeds in male with palms elongated, slender; fingers almost straight, and meeting along their inner edges..*tribulus*

Lepteces.

Chelipeds much smaller than the ambulatory legs...............................*ornatus*

Hyastenus.

A′ Carapace smooth above, two-spined. Præocular angle subacute.......*diacanthus*
A″ Carapace nearly smooth above, three-spined. Præocular angle obtuse..*caribbæus*
A‴ Carapace tuberculose or spinulose. Præocular angle with a sharp spine.
B′ Subhepatic region with a prominent spine ....*Hyastenus*, sp.
B″ Subhepatic region without a prominent spine...................................*longipes*

Naxia.

Carapace covered with strong spines. Rostral horns parallel for half their length ....*robillardi*

Scyra.

Carapace with a tubercle at the postero-lateral angle..........................*acutifrons*

Eurynome.

Carapace triangular. Legs spinuliferous. Superior orbital fissure open .....*aspera*

Pelia.

A′ Hands in male with margins tapering to the fingers, which have their edges meeting throughout..*pacifica*
A″ Hands in male with margins subparallel; fingers gaping at base.
B′ Basal antennal joint with its distal half visible from above.
C′ Rostrum moderately deflexed..*mutica*
C″ Rostrum strongly deflexed..*rotunda*
B″ Basal antennal joint with only its extremity visible from above.....*Pelia*, sp.

Nibilia.

Ambulatory legs armed with spines..*erinacea*

Schizophrys.

Carapace covered with granules and small spines..............................*aspera*

Pseudomicippa.

Carapace with prominent tubercles. Sternum without granulated crests ...*varians*

Micippa.

A′ Rostrum terminating in four spines ....*mascarenica*
A″ Rostrum terminating in two lobes.
B′ Lobes rounded externally, with the antero-internal angles acute.......*spinosa*
B″ Lobes narrow or spinous ....*thalia*

Hemus cristulipes A. Milne Edwards.

Miss. Sci. au Mexique, pt. 5, I, p. 88, pl. XVI, fig. 1, 1875. Miers, Jour. Linn. Soc. London, XIV, p. 654, 1879. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 45, pl. 3, fig. 6, 1889.

Off Cape Catoche, Yucatan, lat. 22° 07′ 30″ N., long. 87° 06′ W., 21 fathoms, white rock, coral; station 2363, U. S. Fish Commission steamer *Albatross*, 1885; one female (15167).

Length, 7; greatest width, 5.7mm.

Previously recorded from the Gulf of Mexico and Central America.

Hyas araneus (Linné).

Cancer araneus Linné, (Syst. Nat., ed. 12, p. 1044, 1766).
Hyas araneus Leach (Mal. Podoph. Brit., pl. XXI A, 1815); Trans. Linn. Soc. London, XI, p. 328, 1815, and synonymy. Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 179, 1860. Packard, Mem. Boston Soc. Nat. Hist., I, p. 302, 1867 (*aranea*). Smith, Trans. Conn. Acad., V, p. 43, 1879. Carrington and Lovett, Zoölogist (3), V, p. 414, 1881. Miers, Challenger Rept., Zoöl., XVII, p. 47, 1886 (*aranea*), and synonymy. Scott, 6th Ann. Rept. Fishery Board for Scotland, pt. III, p. 255, 1888. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 45, pl. 1, figs. 1-5, 1889. G. Y. and A. F. Dixon, Proc. Roy. Irish Acad. (3), II, p. 30, 1891 (habits).

RECORD OF SPECIMENS EXAMINED.

Bjonen's Bay, Spitzbergen, 7 to 10 fathoms; Dr. Eckstein, U. S. Navy, U. S. S. *Alliance*, August 10, 1881 (4514).
Kielerbucht, Germany; K. Möbius (3304).
Hebrides; A. M. Norman (6317).
Greenland; Dr. Pavy, Howgate Expedition (3571).
Disco, Godhavn Harbor, Greenland; Ensign H. G. Dresel, U. S. Navy, July, 1883 (14990).
Labrador; W. Henry (16280); L. M. Turner, November, 1882 (5844).
L'Anse au Loup and Forteau Bay, Labrador, 15 to 25 fathoms, sand, kelp, and dirt; W. A. Stearns, 1882 (5242, 10031).
St. Johns, Newfoundland; U. S. Fish Commission, 1885 (10138).
Gulf of Maine; U. S Fish Commission (3826).
Gloucester, outer harbor, Mass., 8 to 10 fathoms; U. S. Fish Commission (2867).
Off Cape Cod, Mass., 15 to 106 fathoms; U. S. Fish Commission.
Eastern coast of New England; S. M. Johnson and Bro. (3319).
Northeast coast of North America; U. S. Fish Commission steamer *Albatross*, 1885 and 1886:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Remarks.
				Fath.	Temp.	Materials.		
		° ′ ″	° ′ ″		°			
10218	2431	43 00 00	50 47 30	129	33.5	yl. S. bk. Sp.	June 23	
10220	2437	43 36 00	50 05 00	37	35.8	crs. brk. Sh. brk. St.	24	
10221	2438	43 36 00	50 03 50	37	36.8	gn. S. bk. Sp. brk. Sh.	24	
10222	2439	43 37 00	49 56 30	36	37.8	wh. S. bk. Sp.	24	
10224	2444	45 59 00	49 45 30	39	34.4	wh. S. brk. Sh	25	
10225	2445	46 09 30	49 48 30	39	33.5	brk. Sh.	25	Abundant.
10226	2446	46 20 00	49 52 00	40	35.3	brk. Sh.	25	Abundant.
10229	2452	47 04 00	50 48 00	89	29.7	fne. gn. S.	26	
10230	2461	45 47 00	54 13 30	59	30	fne. S. bk. Sp.	July 3	
10231	2463	45 44 00	54 27 00	45	30	brk. Sh.	3	Abundant.
10232	2464	45 40 00	54 41 00	42	32	wh. bk. S. brk. Sh.	3	Abundant.
10233	2465	45 35 00	55 01 00	67	30	bk. gy. S.	3	
10234	2466	45 29 00	55 24 00	67	30	Co.	3	Abundant.
10235	2467	45 23 00	55 41 00	38	35.8	fne. wh. S. bk. Sp.	3	
10236	2467	....	....	....	....	....		3 from stomach of cod.
10237	2468	45 11 30	55 51 30	42	33	fne. bk. S.	3	
10238	2472	44 27 30	57 10 45	137	40	crs. S. G.	4	
10239	2474	44 28 30	57 10 45	133	40	hrd.	4	
10240	2490	45 27 30	58 27 45	50	....	G. P.	6	
10241	2492	45 22 00	58 43 45	75	33.3	wh. S.	6	Abundant.
10245	2496	45 07 30	59 27 45	44	32.2	crs. yl. S. P.	6	Stomach of cod.
10247	2503	44 22 30	61 00 15	47	35	P.	7	Stomach of cod.
11867	2698	45 07 00	55 09 00	90	....	gy. S. bk. Sp. P.	Aug. 22	
11868	2699	45 04 00	55 23 00	72	....	Co.	22	Abundant.
11870	2701	44 56 00	55 40 30	75	....	gy. S. bk. Sp.	22	

Gloucester donations, U. S. Fish Commission.

Grand Bank (3781).
St. Peters Bank (14456).
Banquereau, 50 fathoms.
South of Banquereau, 250 to 350 fathoms; one female with eggs (3790).
Off Little Hope Light, Nova Scotia, 35 to 60 fathoms (3783).

The largest specimen is that presented by S. M. Johnson & Bro., the exact locality unknown. Length of carapace, 94; width, 72 millimeters.

Besides the range indicated above, this species has been recorded from France, Norway, Iceland, and the sea of Okhotsk, by various authors (Smith, loc. cit.).

Hyas coarctatus Leach.

Hyas coarctatus Leach, (Mala. Podoph. Brit., pl. XXI B, figs. 1 and 2, 1815); Trans. Linn. Soc. London, XI, p. 329, 1815. Leidy, Jour. Phila. Acad. (2), III, p. 17, 1855. Stimpson, Boston Jour. Nat. Hist., VI, p. 450, 1857. Packard loc. cit. (*coarctata*). Smith, Rept. U. S. Fish Commr. for 1871 and 1872 (1874), p. 548; Trans. Conn. Acad., V, p. 43, 1879; Rept. U. S. Fish Commr. for 1882 (1884), p. 347; for 1885 (1887), p. 626. Lockington, Proc. Cal. Acad. Sci., VII, p. 65, 1876. Carrington and Lovett, Zoölogist (3), V, p. 415, 1881. Miers, Challenger Rept., Zoöl., XVII, p. 48, 1886, (*coarctata*), and synonymy. Scott, op. cit., p. 256. Aurivillius, op. cit., p. 46, pl. 1, fig. 6.

Hyas latifrons Stimpson, Proc. Phila. Acad. Nat. Sci., IX, p. 217, 1857. Lockington, op. cit., p. 64. Smith, Trans. Conn. Acad., V, p. 45, 1879. Murdoch, Rept. of Exped. to Point Barrow, Alaska, p. 137, 1885. Aurivillius, op. cit., p. 46, (Greenland).

Stimpson's species *latifrons* is based chiefly on the shorter, broader, less acute rostrum, the closed orbital fissures, and the broader anterior portion of the carapace as compared with *coarctatus*. A large number of specimens from many different localities along the Atlantic and Pacific coasts have been examined and the following observations made: In the specimens 2 inches or more in length from the Atlantic, ranging from Nova Scotia to Greenland and from shallow water to 81 fathoms, the rostral horns are short and blunt and the orbital fissures are closed, or in a few specimens very narrowly open, varying in different individuals from the same locality. The width of the anterior portion of the carapace is from 0.76 to 0.87 of the branchial width. From Bering Sea and the Arctic coast of Alaska vast numbers of large specimens have been obtained by various collectors, including an interesting series from off Bristol Bay collected by the Fish Commission steamer *Albatross* during the summer of 1890. They are not only variable in width, but the orbital fissures, while usually closed, are not uniformly so. The rostral horns are always rather short, broad, and obtuse. The width of the anterior portion of the carapace varies from 0.69 to 0.85 of the branchial width, the narrowest specimens being larger than any that have been obtained from the Atlantic. The two series of large specimens from the Atlantic and Pacific coasts are absolutely indistinguishable, as the minor characters mentioned by Stimpson, the swollen carapace, the number of tubercles, and the obtuseness of the angles, all vary with the individual.

In smaller specimens the orbital fissures are usually open, the rostrum proportionally longer than in larger forms, and the anterior width is greater, varying from 0.86 to 0.92 of the branchial width. The only European specimens which I have at hand are seven from the Shetland Islands and one from Kielerbucht. The former are from 1 to 1½ inches in length, have a very long rostrum, wide orbital fissures, and are of medium width anteriorly. The merus joints of the ambulatory legs are unusually long. This form, which is probably the typical *coarctatus*, we find reproduced in large numbers on the Atlantic coast of

North America, except that the merus joints are rarely as long. Occasional specimens of small size, however, have a shorter rostrum and fissures narrow or almost closed. Small specimens from the Pacific coast, while having, as a rule, the orbital fissures open (this character being present even among Stimpson's types), more often exhibit narrower fissures than do individuals from Europe and Eastern North America. This variation of many of the small Pacific forms from the normal type is of no special significance, as the same variation occurs even on the Atlantic side. Specimens from Greenland, three-fourths of an inch long, with fissures very slightly open, are identical in form with others of the same size from Bering Sea; while it is impossible to separate specimens with open fissures found on Georges Bank from others found north of the Alaskan Peninsula.

Length of largest specimen, 80; greatest width, 64.5; length of cheliped, about 144 millimeters.

The following tables show the comparative width of the anterior and posterior portions of the carapace in various males from the Atlantic and Pacific oceans:

ATLANTIC.

Locality.	Branchial width.	Hepatic width.	Ratio of branchial to hepatic width.
Greenland	48.5	37	1: .76
Station 2460	48	39	1: .81
Arichat, Nova Scotia	43.5	37	1: .85
Labrador	33.5	27	1: .8
Station 2455	32	28	1: .87
Shetland	22.5	18.5	1: .82
Off Cape Cod	19	16.7	1: .88
Do	19	16.5	1: .87
Off Georges Bank	17	15.6	1: .92
Do	16	14	1: .87
Off Cape Ann	12	10.8	1: .9
Grand Manan	10.5	9	1: .86

PACIFIC.

Locality.	Branchial width.	Hepatic width.	Ratio of branchial to hepatic width.
Station 3251	64.5	44.5	1: .69
Norton Sound	59.3	43	1: .72
Station 3248	57.3	42	1: .73
Plover Bay	54	41	1: .76
Bering Sea (type of *latifrons*)	53.5	44	1: .82
Plover Bay	37.5	31	1: .83
Station 3251	36	28.5	1: .79
Do	29.5	24	1: .81
Plover Bay	28.3	24	1: .85
Bering Sea (type of *latifrons*)	27	23	1: .85
Plover Bay	22	20	1: .91
Station 3281	18.5	16.5	1: .89
Station 3288	17	15	1: .88
Station 3282	15.5	13.5	1: .87
Bering Strait	15.5	14	1: .9
Do	13	12	1: .92

RECORD OF SPECIMENS EXAMINED.

Shetland; A. M. Norman (6319, 9060).
Kielerbucht, Germany; K. Möbius (16286).
U. S. Fish Commission:
  Off Chesapeake Bay, 18 to 373 fathoms.
  Off Martha's Vineyard, 26 to 158 fathoms.
  Off Nantucket Shoals, 18 to 62 fathoms.
  Off Georges Bank, 35 to 906 fathoms.
  Le Havo Bank, 45 fathoms.
  Off Cape Cod, Massachusetts, 16 to 90 fathoms.
  Massachusetts Bay, 45 to 90 fathoms.
  Off Cape Ann, Massachusetts, 7 to 42 fathoms.
  Gulf of Maine, 23 to 98 fathoms.
  Grand Manan, New Brunswick.
  Off Halifax, Nova Scotia.
Arichat Harbor, Cape Breton, Nova Scotia, 30 fathoms, stomach of cod; W. A. Stearns (15289).
Henley Harbor, Labrador, shallow water; W. A. Stearns (5240).
Greenland; Dr. Pavy, Howgate Expedition (5239).
Disco Harbor, Greenland; Ensign H. G. Dresel, U. S. Navy, Greely Relief Expedition (13988).
Lat. 70° 20′ N., long. 56° W., 90 fathoms; Ensign C. S. McClain, U. S. N., U. S. S. *Alert* (13759).

Stations of the U. S. Fish Commission steamer *Albatross*, 1885 and 1886:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom. Fath.	Bottom. Temp.	Bottom. Materials.	Date.
		° ′ ″	° ′ ″		°		
10208	2455	47 21 00	51 38 30	81	30	br. S	June 26
10209	2456	47 29 00	52 18 00	86	......	G	July 2
10212	2460	45 50 00	54 06 00	67	30	gy. S. Sh	3
10213	2463	45 44 00	54 27 00	45	30	brk. Sh	3
16287	2466	45 29 00	55 24 00	67	30	Co.	3
10214	2490	45 27 30	58 27 45	50	......	G. P	6
10215	2498	44 54 00	59 46 45	65	......	fine br. S	6
10216	2503	44 22 30	61 00 15	47	35	P	7
10217	2509	44 30 00	63 18 00	43	34.8	crs. S	8
10248	2525	41 49 00	65 49 30	72	43.6	S. G. brk. Sh	13
11872	2692	46 50 00	44 35 00	73	......	gy. S. sml. bk. St	Aug. 11
11873	2694	46 52 30	44 54 30	86	......	gy. S. bk. Sp	11

Arctic and Pacific Oceans:

Cat. No.	Locality.	Depth.	Materials.	Collector.
7852	Cape Smyth, Alaska	Beach.		U. S. Signal Service.
7878	10 miles west of Point Franklin	13½	P. S. brk. Sh.	Do.
14730	71° 02′ 00″ N., 157° 46′ 00″ W	19		U. S. R. S. Corwin.
14728	66° 07′ 00″ N., 168° 28′ 37″ W	31		Do.
13590	65° 49′ 15″ N., 169° 04′ 30″ W	26		Do.
14729	Off Point Hope, Alaska	25		Do.
14732	Arctic Ocean			Do.
14738	Off Cape Sabine, Alaska	13	G	W. H. Dall.
14743	66° 45′ 00″ N., 166° 35′ 00″ W	10	S	Do.
14739	Cape Prince of Wales, Alaska	23	M	Do.
14737	Bering Strait	13	G	Do.
14741	12 miles east of Kings Island	17	M	Do.
14740	Plover Bay, Siberia	10–25		Do.
5241	......do	15–20		Do.
14744	East Cape, Siberia			Dr. R. White.
14735	63° 37′ 00″ N., 165° 19′ 00″ W	12		Lieut. George M. Stoney, U. S. Navy.
14734	62° 54′ 00″ N., 166° 38′ 00″ W	22		Do.
14733	60° 22′ 00″ N., 168° 45′ 00″ W			Do.
2100	Bering Sea (types of *latifrons*)			North Pacific Exploring Expedition.

Bering Sea; U. S. Fish Commission Steamer *Albatross*, 1890 and 1891:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom. Fath.	Bottom. Temp.	Bottom. Materials.	Date.	Remarks.
		° ′ ″	° ′ ″		°			
15870	3246	58 26 30	161 36 00	$17\frac{1}{2}$	38	G	June 9	
15871	3248	58 34 15	162 22 00	21	43	fne. gy. S. G.	13	
15872	3250	58 11 30	163 02 45	$17\frac{1}{3}$	40.2	gy. S	13	
15873	3251	57 35 50	164 05 00	$25\frac{1}{2}$	37.5	fne. gy. S	14	Abundant.
15874	3252	57 22 20	164 24 40	$29\frac{1}{3}$	44.8	bk. M	14	
15875	3253	57 05 50	164 27 15	36	35	M. S	14	
15876	3278	56 12 30	162 13 00	47	38.8	fne. gy. S	28	Do.
15877	3279	56 25 40	162 39 15	41	37	fne. gy. S	28	
15878	3280	56 27 00	162 08 00	36	41	fne. gy. S	28	
15879	3281	56 14 00	161 41 15	36	....	gy. S. bk. Sp	28	
15880	3282	56 30 45	161 50 15	53	38.2	fne. S. gn. M	29	Do.
15881	3283	56 28 00	161 16 30	39	40.3	fne. gy. S	29	
15882	3284	56 16 30	161 53 00	25	43	fne. G	29	
15883	3286	56 39 30	160 20 00	37	41 5	fne. gy. S. Sh. Gr.	July 17	Do.
15884	3288	56 26 30	160 00 00	15	45.5	bk. G	17	Do.
15885	3201	56 58 30	159 11 00	26	41.2	bk. S. G.	18	
15886	3292	57 14 00	159 35 00	32	....	bk. S. G	18	
15887	3293	57 30 00	159 33 00	30	40	fne. gy. S	18	
15888	3294	57 16 45	159 03 30	39	41	bk. G	18	
15889	3297	57 38 00	159 07 30	26	41.5	gy. S	19	
15890	3302	57 45 45	160 12 15	30	40.2	fne. gy. S	21	
15891	3303	57 27 00	160 23 30	33	39.5	bk. S	21	Do.
15893*	3304	58 02 30	161 13 45	28	....	fne. gy. S	21	
15892	3305	57 51 30	161 40 00	23	41.8	fne. gy. S	22	
15894	3306	57 24 30	161 17 00	33	38.9	fne. gy. S	22	Do.
17077	3438	57 06 30	170 22 30	20	....	fne. gy. S. Sh	Aug. 3	
17078	3439	57 06 00	170 35 00	41	44	fne. bk. S	3	

Hyas lyratus Dana.

Plate III.

Amer. Jour. Sci. (2), XI, p. 268, 1851; Crust. U. S. Expl. Exped, I, p. 86, pl. I, fig. 1, 1852. Stimpson, Jour. Boston Soc. Nat. Hist., VI, p. 450, 1857. Lockington, Proc. Cal. Acad. Sci., VII, p. 64, 1876. Miers, Challenger Rept., Zoöl., XVII, p. 47, 1886.

Large specimens of this species show characteristics somewhat different from the example figured by Dana. The carapace is very broad posteriorly, strongly tuberculate. The tubercle at the middle of the posterior margin is large and rounded. There is a subacute tubercle on the posterior margin of the wing-like expansion. The tubercle at the antero-external angle of the basal antennal joint is large, smooth, and constricted at base. Chelipeds long and strong; merus and carpus tuberculate; merus with a ridge of large, irregular tubercles above; hand slightly compressed, roughly granulate, ridged above. Ambulatory legs, slightly pubescent except the dactyls, which are densely so.

Dimensions of three largest males.

Cat. No.	Length.	Branchial width.	Hepatic width.	Length of cheliped, about—	Length of first ambulatory leg, about—	Length of fourth ambulatory leg, about—
5872	105	80	61	200	189	134
5243	100	78	69	200	189	132
15922	85	67	49.5	159	129	99

The collection in the Museum ranges from the extreme end of the Aleutian Islands eastward and southward to Puget Sound. Stimpson

says this species "inhabits deep water on the coast of Oregon, where it was found by the United States Exploring Expedition." Dana, on the contrary, in describing the Crustacea from that expedition, records this species only from Puget Sound.

RECORD OF SPECIMENS EXAMINED.

Cat. No.	Locality.	Fathoms.	Materials.	Collector.	Remarks.
14720	Chichagoff Harbor, Attu	5–7	S. G	W. H. Dall	
14721	Kyska Harbor	7–14	S	do	
14726	Constantine Harbor, Amchitka	6–10	S. St	do	
14767	Bay of Islands, Adakh	9–16	S. M	do	
14722	Captains Harbor, Unalaska	25–75	crs. S	do	Abundant.
14724	Belkoffsky Bay	15–25	Sh. Gr	do	
12504	Port Levasheff			do	
14718	Coal Harbor, Unga	6–9	S. St. M	do	Do.
14727	Chajafka Cove, Kadiak	12–14	S. M	do	Do.
14719	Off Marmot Island			do	
12510	Kachekmak Bay, Cook's Inlet	20–60	sdy. M	do	
14725	Port Etches	5–18	G. St	do	Do.
14766	Sitka Harbor	15	G. M	do	
5243	Wrangel			Dr. W. H. Jones, U. S. Navy.	
14841	Nakat Harbor			Lieut. Commander H. E. Nichols, U. S. Navy.	
5672	Port Wrangel			do	
16279	Steamer Bay			do	
5777	Menzies Bay, Discovery Passage, B. C.	6	soft	do	
15798	Victoria, B. C			Dr. C. F. Newcombe.	
15539	Kadiak, Alaska			U. S. Fish Commission.	
15541	Port Townsend, Wash			do	

Stations of the U. S. Fish Commission steamer *Albatross*, 1888 and 1890:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Remarks.
				Fath.	Temp.	Materials.		
		° ′ ″	° ′ ″		°			
15531	2841	54 18 00	165 55 00	56	41	P	July 23	
15533	2842	54 15 00	166 03 00	72	41	P	23	Abundant.
15532	2843	53 56 00	165 56 00	45	43.5	brk. Sh. P	28	
15537	2844	53 56 00	165 40 00	54	42	gy. S	28	
15542	2847	55 01 00	160 12 00	48	42	fne. gy. S	31	
15534	2848	55 10 00	160 18 00	110	41	gn. M	31	
15535	2849	55 16 00	160 28 00	69	43	gn. M	Aug. 2	
15543	2851	54 55 00	159 52 00	35	44.8	gy. S. brk. Sh	4	
15538	2852	55 15 00	159 37 00	58	41.8	bk. S	4	
15540	2854	56 55 00	153 04 00	60	42.8	bk. S	10	
15896	2855	57 00 00	153 18 00	69	44	gn. M	10	
15536	2856	58 07 00	151 36 00	68	44	gy. S. bk. sp	Aug. 22	
15897	2857	58 05 00	150 46 00	51	44.6	brk. Sh. gy. S	22	
15898	3213	54 10 00	162 57 30	41		bk. S	May 21	Do.
15899	3216	54 20 30	163 37 00	61		bk. S. M	21	
15900	3219	54 14 00	164 35 00	59	38	bk. S. G	22	
15901	3220	54 15 00	165 06 00	34		G. brk. Sh	22	
15902	3222	54 20 00	165 30 00	50	39.7	bk. S. P. Sh	22	Do.
15903	3223	54 26 15	165 32 00	56	39	bk. P	22	
15904	3231	58 35 00	157 28 50	12		S	June 2	
15905	3232	58 31 30	157 34 15	$10\frac{1}{2}$		P. St	2	
15906	3233	58 23 45	157 42 45	$7\frac{3}{4}$	41.5	S. P	2	
15907	3235	58 16 30	158 13 00	11		bk. S	7	
15908	3236	58 11 00	158 05 30	$14\frac{3}{4}$	39	G. S. Sh	7	
15909	3241	58 38 30	159 33 30	14	38	bk. M	8	
15910	3257	54 49 00	165 32 00	81	39	gy. S. G	24	
15911	3258	54 48 00	165 13 30	70	39	bk S. G	24	
15912	3259	54 40 50	165 05 30	41	40.6	bk. S. G	24	
15913	3267	55 23 30	163 29 00	32	41	bk. S	25	
15914	3272	55 31 40	163 07 00	31	42	bk. rd. S	27	
15915	3277	55 58 45	161 46 30	18	43.2	G. S. R	28	
15916	3278	56 12 30	162 13 00	47	38.8	fne. gy. S	28	
15917	3279	56 25 40	162 39 15	41	37	fne. gy. S	28	
15918	3280	56 27 00	162 08 00	36	41	fne. gy. S	28	

Stations of the U. S. Fish Commission steamer *Albatross*, 1888 and 1890—Continued.

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Remarks.
				Fath.	Temp.	Materials.		
		° ′ ″	° ′ ″					
15919	3281	56 14 00	161 41 15	36	....	gy. S. bk. sp.	June 28	
15920	3282	56 30 45	161 50 15	53	38.2	fne. S. gn. M	29	
15921	3283	56 28 00	161 16 30	39	40.3	fne. gy. S	29	
15922	3284	56 16 30	160 53 00	25	43	fne G..............	29	Abundant.
15923	3286	56 39 30	160 29 00	37	41.5	fne. gy. S. Sh. G	July 17	
15924	3288	56 26 30	160 00 00	15	45.5	bk. G	17	
15925	3291	56 58 30	159 11 00	26	41.2	bk. S. G............	18	
15926	3292	57 14 00	159 35 00	32	....	bk. S, G............	18	
15927	3293	57 30 00	159 33 00	30	40	fne. gy. S	18	
15928	3294	57 16 45	159 03 30	30	41	bk. G	18	
15929	3296	57 26 30	158 46 00	24	43	gy. S. bk. Sp	19	
15930	3300	58 12 30	159 55 00	15	42.2	P..................	20	
15931	3301	58 12 45	160 37 30	17	....	fne. gy. S	20	
15938	3302	57 45 45	160 12 15	30	40.2	fne. gy. S	21	
15932	3306	57 24 30	161 17 00	33	38.9	fne. gy. S	22	
15933	3311	53 59 36	166 29 43	85	41	gn. M..............	Aug. 15	
15934	3313	54 01 51	166 27 38	68	42.7	fne. bk. S	15	
15935	3319	53 40 30	167 30 00	59	40.8	bk. S	18	
15936	3320	53 40 00	167 20 45	59	40.8	bk. S. Co...........	18	
15937	3335	53 58 05	166 33 25	93	40.8	M	22	

Chionœcetes opilio (O. Fabricius).

Pl. IV, Figs. 5–7.

Cancer Phalangium O. Fabricius, (Fauna Grœnl., p. 234, 1780).

Cancer opilio O. Fabricius (Kongelige Danske Vid. Selsk. Skr. nye Saml., III, 181, plate, 1788).

Chionœcetes opilio Kröyer, Natur. Tidskrift (1), 2, p. 249, 1838 (in Gaimard, Voyages en Scandinavie, etc., Crust., pl. 1, 1839). Dana, Crust. U. S. Expl. Exped., I, p. 78, 1852. Miers, Jour. Linn. Soc. London, XIV, p. 654, 1879. Smith, Trans. Conn. Acad., V, p. 41, 1879, and synonymy. Murdoch, Rept. of the International Polar Expedition to Point Barrow, Alaska, p. 137, 1885, and synonymy. Aurivillius, K. Sv. Vet.-Akad. Hand., 23, 1, p. 46, 1889.

Chionœcetes behringianus Stimpson, Proc. Boston Soc. Nat. Hist., VI, p. 84, 1857; Jour. Boston Soc. Nat. Hist., VI, p. 449, 1857; Proc. Acad. Nat. Sci. Phila., IX, p. 217, 1857. Lockington, Proc. Cal. Acad. Sci., VI, p. 64, 1876.

Peloplastus Pallasii Gerstæcker, Archiv für Natur., XXII, 1, p. 105, pl. 1, fig. 1, 1856 (April, 1857).

This well known species is represented in the collection by a large series ranging from the fishing banks off Newfoundland northward to Greenland, and from the Arctic coast of Alaska southward through Bering Strait and along the eastern and western shores of Bering Sea to the Aleutian Islands, where it is found in abundance, and thence eastward and southward along the Alaskan coast to British Columbia. It ranges in depth from shallow water to 206 fathoms on the Atlantic coast and 121 fathoms on the Pacific. In many of the lots collected by the steamer *Albatross* along the Alaskan peninsula the spines of the ambulatory legs are sharper than in typical specimens. This is, however, the only difference observed.

The largest specimen is from southeastern Alaska (16292) and has a span of 2½ feet with the following dimensions: Length, 127; width, 135; length of cheliped, about 256; length of first ambulatory leg, about 340 millimeters.

Prof. S. I. Smith records this species on the Atlantic coast as far south as off Casco Bay, Maine.

RECORD OF SPECIMENS EXAMINED.

Fishing banks off Newfoundland; U. S. Fish Commission steamer *Albatross*, 1885 and 1886:

Cat. No	Station.	Lat. N.	Long. W.	Bottom. Fath.	Bottom. Temp.	Bottom. Materials.	Date.
		° ′ ″	° ′ ″		°		
10207	2453	47 10 00	51 02 00	82	29.7	gn. M. fne. S	June 26
10206	2457	47 13 00	52 24 00	86	29.5	gy. S	July 2
10304	2459	46 23 00	52 45 00	88	29.5	crs. gy. S	2
10305	2461	45 47 00	54 13 30	59	30	fne. S. bk. Sp	3
11874	2307	47 40 00	47 35 30	206	......	gn. M. bk. Sp	Aug. 12

Greenland to Bering Sea and British Columbia:

Cat. No.	Locality.	Fathoms.	Materials.	Collector.
13770	Godhavn, Greenland			Ensign C. S. McClain, U. S. N.
13784	? Greenland			Do.
9231	Waigatt Channel, N. Greenland			
16308	Greenland			Copenhagen Museum.
7879	10 miles west of Pt. Franklin, Alaska	13½	S	U. S. Signal Service.
14699	Arctic Ocean			U. S. R. S. Corwin.
14697	? Arctic Ocean			Do.
14700	Off Point Hope, Alaska	25		Do.
14698	66° 30′ to 52′ N., 167° 14′ to 168° 08′ W	19–30		Do.
14696	65° 25′ to 28′ N., 171° 11′ to 26′ W	6¼–11		Do.
2031	Bering Strait (types of *behringianus*)			North Pacific Expl. Exped.
14694	66° 12′ N., 168° 54′ W			Lieut. Geo. M. Stoney, U. S. N.
14701	63° 37′ N., 165° 19′ W	12		Do.
14695	60° 22′ N., 168° 45′ W			Do.
14680	Mouth of Port Clarence, Bering Strait	7–12		W. H. Dall.
14683	Port Providence, Siberia	8–20	M	Do.
14684	Kyska Harbor, Alaska	9–12	sdy. M	Do.
13114	Bay of Islands, Adakh	9-16	S. M	Do.
14776	Nazan Bay, Atka	10–16	S	Do.
13140	Captains Bay, Unalaska	Beach	Sh., etc	Do.
14689	Eider Village anchorage, Captains Bay			Do.
14675	Captains Harbor	9–16		Do.
13123	Captains Har., bet. S. Flat and W. Hd.	30	S	Do.
14685	Captains Harbor, inside of ridge	60–80	S. St	Do.
13133	Captains Harbor, ridge	80	S	Do.
14692	Captains Harbor, outside of ridge	25–75	crs. S	Do.
14774	Iliuliuk Harbor, Unalaska	10	Shingle	Do.
13113	Iliuliuk	10-12	M. St	Do.
13119	Iliuliuk, off village	15	gy. S	Do.
14773	Port Levasheff, Unalaska	20–30	M. Sh.	Do.
13138	Between Pinnacle and Ulakhla	16		Do.
3512	Unalaska	Beach		Do.
14679	Coal Harbor, Unga			Do.
14686	......do	3	Shingle	Do.
14682	......do	8–9	S. St	Do.
14681	Off Round Island, Coal Harbor	6–8	M	Do.
14687	Popoff Strait, Shumagins			Do.
14674	Sanborn Harbor, Nagai	Shoal water	Under stones	Do.
13121	Chiachi Islands	20	M	Do.
13128	Chignik Bay	7–18	S	Do.
12526	Chajafka Cove, Kadiak	15–20	G	Do.
13677	Chajafka Cove, Kadiak	12 14	M. S	Do.
14688	Kachekmak Bay, Cooks Inlet	20–60	sdy. M	Do.
14691	Port Etches	12–18		Do.
14775	Port Mulgrave, Yakutat Bay	6–40		Do.
14772	Sitka Harbor	15	G. M	Do.
15473	Kadiak			U. S. Fish Commission.
5795	Wrangel			Dr. W. H. Jones, U. S. N.
16292	Southeastern Alaska			
8353	Wrangel			Lieut. Comdr. H. E. Nichols, U. S. N.
5862	British Columbia			Do.

Alaska; U. S. Fish Commission steamer *Albatross*, 1888, 1890, and 1891:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Remarks.
				Fathoms.	Temp.	Materials.		
		° ′ ″	° ′ ″					
15472	H. 1166	54 00 00	163 45 00	45	41.7	fne. gy. S	July 22	Stomach of cod.
15471	2844	53 56 00	165 40 00	54	42	gy. S	28	
15475	2847	55 01 00	160 12 00	48	42	fne. gy. S	31	
15467	2848	55 10 00	160 18 00	110	41	gn. M	31	Abundant.
15469	2849	55 16 00	160 28 00	69	43	gn. M	Aug. 2	
15476	2851	54 55 00	159 52 00	35	44.8	gy. S. brk. Sh	4	
15470	2852	55 15 00	159 37 00	58	41.8	bk. S. M	4	
15468	2855	57 00 00	153 18 00	69	44	gn. M	10	
15826	3216	54 20 30	163 37 00	61	....	bk. S. M	May 21	Very abundant.
15827	3219	54 14 00	164 35 00	59	38	bk. S. G	22	
15828	3224	54 42 50	165 37 00	121	38.7	bk. S. G	22	
15829	3225	54 48 30	165 49 00	85	38.6	bk. S	22	Abundant.
15830	3251	57 35 50	164 05 00	25½	37.5	fne. gy. S	June 14	Do.
15831	3252	57 22 20	164 24 40	29½	44.8	bk. M	14	Very abundant.
15832	3253	57 05 50	164 27 15	36	35	m. S	14	Do.
15833	3255	56 33 30	164 31 40	43	37	gn. M. S	14	Abundant.
15859	3256	56 18 00	164 34 10	49	35	gn. M. brk. Sh	14	Do.
15834	3257	54 49 00	165 32 00	81	39	gy. S. G	24	Do.
15835	3258	54 48 00	165 13 30	70	39	bk. S. G	24	
15836	3259	54 40 50	165 05 30	41	40.6	bk. S. G	24	
15837	3263	55 04 00	165 04 00	61	39.5	bk. M	24	Do.
15838	3272	55 31 40	163 07 00	31	42	bk. rd. S	27	
15839	3278	56 12 30	162 13 00	47	38.8	fne. gy. S	28	
15840	3279	56 25 40	162 39 15	41	37	fne. gy. S	28	
15841	3280	56 27 00	162 08 00	36	41	fne. gy. S	28	
15842	3281	56 14 00	161 41 15	36	....	gy. S. bk. Sp	28	
15843	3282	56 30 45	161 50 15	53	38.2	fne. S. gn. M	29	Very abundant.
15844	3286	56 39 30	160 29 00	37	41.5	fne. gy. S. Sh. G	July 17	
15845	3288	56 26 30	160 00 00	15	45.5	bk. G	17	
15846	3306	57 24 30	161 17 00	33	38.9	fne. gy. S	22	
15847	3309	56 56 00	172 55 00	71	37.9	gn. M	Aug. 4	
15848	3310	53 56 51	166 28 53	58	41.5	fne. dk. S. M	15	
15849	3311	53 59 36	166 29 43	85	41	gn. M	15	Do.
15850	3312	53 59 11	166 25 09	45	43	fne. S. M	15	
15851	3313	54 01 51	166 27 38	68	42.7	fne. bk. S	15	Abundant.
15852	3321	53 33 30	167 15 40	54	41.5	dk. M	18	
15853	3333	53 53 35	166 30 15	19	43.9	gn. M	22	Very abundant.
15854	3334	53 56 20	166 29 15	50	42.6	M. S	22	
17073	3438	57 06 30	170 22 30	20	....	fne. gy. S. Sh	Aug. 3	
17074	3439	57 06 00	170 35 00	41	44	fne. bk. S	3	Abundant.
17075	3440	57 05 00	170 41 00	48	....	bk. M. Sh	3	
17076	3441	57 04 20	170 52 30	51	39	bk. M. Sh	3	
17097	3442	57 10 00	170 47 15	47	40	bk. M. Sh	3	

Chionœcetes tanneri, sp. nov.

Plate IV, Figs. 1-4.

There exists in the deeper waters on the Pacific coast of North America from Bering Sea to the southern extremity of California a species of *Chionœcetes* closely allied to *opilio*, but possessing striking differences.

The carapace is much swollen at the branchial regions, which are distended both vertically and laterally, concealing the lateral margin of the carapace. Between the two branchial regions along the median line there is a deep, narrow, triangular depression which widens out anteriorly and joins the depressions between the gastric and branchial regions. The carapace is covered with spines instead of granules or tubercles. The most conspicuous spines on the carapace are arranged in irregular rows, one of which extends transversely across the anterior part of the gastric region; a second row extends from behind the orbits diagonally backward across the branchial region; a third row extends from near the inner angle of the branchial region almost transversely

to the outer margin, from which point a row of long spines extends forward along the lateral margin and is continued on the pterygostomian regions. This marginal row of long spines, while forming the apparent lateral margin, really overhangs and conceals the real margin. This is a conspicuous difference between this species and *opilio*, in which the branchial region is flattened out so that the postero-lateral margin is visible in a dorsal view to a point just back of the cheliped. From the lateral row of long spines a small row of three or four spines extends up on the carapace near the anterior part of the branchial region. Small, sharp spines border the orbits, the outer margin of the postocular teeth and the infero-lateral and posterior margins.

The rostral horns are longer and narrower than in *opilio*, leaving a widely V-shaped notch between.

The second segment of the abdomen of the male is bent downward at the extremities in almost a right angle. There is a transverse ridge of spiny tubercles on the sternum in front of the abdomen. Anterior to this ridge the sternum is deeply excavated.

The posterior margin of the epistome is strongly deflexed in the center and arched at the sides. The external maxillipeds when in place do not fit closely into the buccal cavity as in *opilio*; merus joints strongly spinose on the margins. On removing the carapace from specimens of *tanneri* and *opilio* of equal size, the gills in the former are seen to be much larger than in the latter, being about two-fifths longer in *tanneri*. There are corresponding differences in the maxillipeds. The scaphognathite of the second maxilla is very much larger (pl. IV, figs. 2 and 5), and also the endopodite of the first maxilliped (figs. 3 and 6). The foliaceous part of the flabellum has about twice the area of the same in *opilio* (figs. 4 and 7).

The legs are armed with spines longer and stouter than those of *opilio*. In adult specimens the ambulatory legs are longer than in *opilio*, especially the merus joints, which are much narrower and in the males do not widen out at the proximal end as in *opilio*. The ambulatory legs of the female are shorter than those of the male, as is the case in *opilio*. In comparing young specimens of both species the difference in the length of the ambulatory legs and in the width of the merus joints is not evident.

The specimen figured is a very large one, in which the spines are more worn and blunt than in medium-sized specimens.

Table of measurements.

Chionœcetes tanneri.						
Station.	Sex.	Length, from base of rostral horns.	Width, without spines.	Approximate length of first ambulatory leg.	Length of merus of first ambulatory leg.	Greatest width of merus of first ambulatory leg.
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
3100	♂	119	130	316	134	18.5
3307	♂	105	111	324	133	19
2923, 2980	♂	73.5	80	177	72	10.5
2923, 2980	♂	72.5	77	187	76	10
2980	♂	67.5	71.5	153	63	8
2871	♂	48	50	116	47	7
3342	♂	32	32	82	32	4.7
2928	♂	31	32.5	73	29	4
2925	♀	88	95	206	84	14
3186	♀	87	94	190	77	15
3188	♀	80	86	171	68	12.5
2923, 2980	♀	73.5	76	148	58	9
2870	♀	70.5	77	180.5	70.5	12.5
3307	♀	69	74	162	64	13
3342	♀	31	32	77	30	5

Chionœcetes opilio.						
Station.	Sex.	Length, from base of rostral horns.	Width, without spines.	Approximate length of first ambulatory leg.	Length of merus of first ambulatory leg.	Greatest width of merus of first ambulatory leg.
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
3252	♂	100	117.5	247	99	22
3253	♂	94	99	226	90	20
2453	♂	89	91	220	90	17.5
3263	♂	75	78	183	74	16
3256	♂	69	71	164	68	15
2848	♂	67	77.5	166	67	14
3310	♂	67	79	172	72	14
3216	♂	56	65	125	48.5	11.5
3311	♂	32	35	76	29	5.5
3256	♀	80	91	150	60	16.5
3263	♀	79	90	150	58	16
3216	♀	65	74	142	53	13
3310	♀	56	64	129	51	11
3311	♀	30.5	34	69.5	27	5.3

RECORD OF SPECIMENS EXAMINED.

Bering Sea to southern California; U. S. Fish Commission steamer *Albatross*, 1888-1890 (stations arranged from north to south):

Cat. No.	Station.	Lat. N.	Long. W.	Bottom. Fath.	Bottom. Temp.	Bottom. Materials.	Date.	Remarks.
		° ′ ″	° ′ ″		°			
15862	3308	56 12 00	172 07 00	1625	35	gn. Oz	Aug. 4	Abundant.
15863	3340	55 26 00	155 26 00	695	36.8	M	29	
15861	3307	53 55 00	170 50 00	1033	35.4	gn. Oz	3	
15864	3342	52 39 30	132 38 00	1588	35.3	gy. Oz. crs. S	Sept. 3	Do.
15478	2860	51 23 00	130 34 00	876	36.5	gn. M	Aug. 31	Do.
15488	3073	47 28 00	125 15 00	477	49.2	gn. M	June 28	Do.
15865	3344	47 20 00	125 07 00	831	36.8	gn. M	Sept. 21	
15485	2871	46 55 00	125 11 00	559	38.4	br. Oz	23	
15474	2870	46 44 00	124 32 00	58	46.5	rky	23	
15866	3346	45 30 00	124 52 00	786	37.3	gn. M	22	
15867	3348	39 02 40	124 06 15	455	47.6	fne. gy. S	25	
15868	3349	38 57 45	124 03 05	239	44.1	bk. S	25	
15860	3100	37 43 20	122 43 00	29	50.4	crs. G	Mar. 10	
15489	3104	37 23 00	123 08 00	391	40.8	C	11	Do.
15493	3112	37 08 00	122 47 00	296	41.8	fne. gy. S	12	
15491	3186	36 18 50	122 06 00	328	41.3	bk. S. M	Apr. 3	
15492	3188	36 08 15	121 49 40	316	45	gn. M	3	
15483	2892	34 15 00	120 36 00	284	44.1	yl. M	Jan. 5	
15477	2980	33 49 45	119 24 30	603	38.9	gn. M	Feb. 12	
15482	2937	33 04 30	117 42 00	464	46.5	gn. M	4	
15481	2928	32 47 30	118 10 00	417	41	bk. S. G	Jan. 23	
15484	2923	32 49 30	117 31 30	822	39	gn. M	19	Do.
15486	2923, 2980							Do.
15487	2925	32 32 30	117 24 00	339	42.9	M	19	
15480	2929	32 27 30	117 26 30	623		gn. M	26	
15479	2919	32 17 00	119 17 00	984	38	gy. M	17	

Herbstia condyliata (Herbst).

Cancer condyliatus Herbst, Natur. der Krabben und Krebse, I, p. 246, pl. XVIII, figs. 99 A, B, 1790.

Herbstia condyliata Milne Edwards, Hist. Nat. Crust., I, p. 302, pl. XIV bis, fig. 6, 1834, and synonymy. Miers, Jour. Linn. Soc. London, XIV, p. 655, 1879; Challenger Rept. Zoöl., XVII, p. 49, 1886. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 47, 1889.

Naples, Italy; A. M. Norman (14509).

This Mediterranean species has also been recorded from the Canaries and Azores.

Herbstia (Herbstiella) camptacantha (Stimpson).

Herbstia parvifrons Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 185, 1860 (not Randall).

Herbstiella camptacantha Stimpson, op. cit., X, p. 94, 1871.

Herbstia camptacantha A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 78, pl. XVIII, fig. 3, 1875.

Mithrax? armatus Lockington, Proc. Cal. Acad. Sci., VII, p. 70, 1876.

Herbstia (Herbstiella) camptacantha Miers, Jour. Linn. Soc. London, XIV, p. 655, 1879; Challenger Rept., Zoöl., XVIII, p. 49, 1886.

The specimens agree very well with Stimpson's description, except that instead of the blunt tooth near the base of the dactyl the edge is minutely serrulate along the gape.

The largest specimen is 13.5 millimeters long and 11 wide.

RECORD OF SPECIMENS EXAMINED.

Catalina Harbor, Cal.; beach (16320); 30 to 40 fathoms, sandy mud (16321); W. H. Dall.

Southern California; W. H. Dall (16322).

San Diego, Cal.; C. R. Orcutt (16323).

Off Magdalena Bay, Lower Cal.; U. S. Fish Commission, 1889:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Sex.
				Fath.	Temp.	Materials.		
		° ′ ″	° ′ ″		°			
1536	2988	24 58 30	115 52 30	34	63.9	Coralline	Mar. 2	1 ♀ with eggs.
1545	2989	24 58 15	115 53 00	36	64.3	Coralline	2	1 ♂

Previously recorded from Acapulco, Mazatlan, and Cape Saint Lucas.

Cœlocerus grandis, sp. nov.

Plate V.

The carapace is oval-orbicular, very convex, armed with many stout, blunt spines, between the spines smooth, finely punctate; regions distinct. There are six spines on the median line, two on the gastric, one on the genital, two on the cardiac, and one on the intestinal region. There is an additional spine on the gastric region on either side and in advance of the first median spine. There is one spine on the upper

surface of the hepatic region and seven on each branchial region, arranged as follows: Two large, widely separated, in a line with the posterior margin of the gastric region; two near the cardiac region arranged almost longitudinally; two forming almost a parallelogram with the latter; and one near the posterior margin. There are five lateral spines, decreasing in size from the large, strong hepatic spine to the last one on the branchial region. On the right side there is an additional small spine above the last lateral spine.

Rostrum broad, upturned; margin thick, involuted. In the specimen in hand, the end of the rostrum is broken off, as are also the flagella of the antennæ. Præocular tooth prominent. Upper orbital fissure closed at its anterior end. Postocular angle dilated outwardly in a stout tooth. Basal antennal joint thick, broadest posteriorly, bearing two teeth on the orbit and two teeth below these, of which the posterior one points downward, outward, and forward, and the anterior one, situated at the antero-exterior angle is very stout, rounded at the end, and projects horizontally forward and slightly inward. In a line with these last two teeth is one below the postocular tooth, pointing downward and another at the angle of the buccal cavity. There are two spines on the subhepatic region, arranged almost longitudinally.

Abdomen of female with a broad carina through the center, a median spine on the first and second segments, and a broad median tubercle on the third. At each end of the second segment there is a broad tubercle, the distal half of which is flattened horizontally.

Chelipeds of the female not so long as the first pair of ambulatory legs. Merus subcylindrical with two or three small spines on the upper surface. Carpus with two or three spiny tubercles. Palms compressed, about twice as long as broad, tapering slightly toward the distal end. Fingers evenly dentate, almost meeting when closed. Ambulatory legs stout, decreasing regularly in length, unarmed except for a tubercle at the upper distal end of the meral joints.

The maxillipeds, lower edge of the carapace, margins of the sternum and abdomen, and especially the anterior portion of the sternum are fringed with long hair. Legs hairy, except the distal two-thirds of the dactyls.

Length of carapace, without rostrum, 98; width, without spines, 87; length of cheliped about 104 millimeters.

One specimen collected by the U. S. Fish Commission steamer *Albatross*, in the Gulf of Mexico, lat. 29° 34′ 30″ N., long. 88° 01′ W., 35 fathoms, yellow sand, black specks, station 2388, March 4, 1885 (9694).

Maia squinado (Herbst).

Cancer squinado Herbst, Natur. der Krabben und Krebse, III, part 3, p. 23, pl. LVI. 1803.

Maia squinado Latreille (Hist. Nat. Crust., VI, p. 93; Ency., pl. CCLXXVII, figs. 1 and 2). Milne Edwards, Hist. Nat. Crust., I, p. 327, 1834, and synonymy. Bell, Brit. Crust., p. 39, fig., 1853. Miers, Jour. Linn. Soc. London, XIV, p. 655, pl. XII, figs. 7, 8, 1879. Carrington and Lovett, Zoölogist (3), V, p. 416, 1881.

RECORD OF SPECIMENS EXAMINED.

Cornwall, England; A. M. Norman (15337).
Channel Islands; Edward Lovett (6548).
Jersey; A. M. Norman (6773, 6774).
Greece (14484).
Locality unknown (15374).

Maia verrucosa Milne Edwards.

Cancer squinado Herbst, op. cit., I, p. 214 (pars), pl. XIV, figs, 84, 85, 1790.
Maia squinado Bosc, (Hist. Nat. Crust., t. I, pl. VII, fig. 3?). Audouin, (Crust. de l'Egypte, par M. Savigny, pl. VI, fig. 4).
Maia verrucosa Milne Edwards, Hist. Nat. Crust., I, p. 328, pl. III, 1834. White, Crust. Brit. Mus., p. 8. 1847. Capello, Jor. Sci. Lisboa, p. (2), 1873. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 47, pl. IV, fig. 2, 1889.

Two male specimens of this Mediterranean species are contained in the collection, with the exact locality unknown; received from Henry A. Ward (16281).

Paramithrax peronii Milne Edwards.

Hist. Nat. Crust., I, p. 324, 1834. White, op. cit., p. 7. Jacquinot et Lucas, Voy. au Pole Sud, Zoöl., III, Crust., p. 10, pl. I, fig. 3, 1853. Miers, Ann. Nat. Hist., (4), XVII, p. 219, 1876; Jour. Linn. Soc. London, XIV, p. 656, 1879. Haswell, Proc. Linn. Soc., N. S. Wales, IV, p. 440, 1879; Ann. Mag. Nat. Hist. (5), V, p. 146, 1880; Cat. Austral. Crust., p. 13, 1882. Filhol, Bull. Soc. Philom., IX, p. 26, 1885. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 48, pl. IV, fig. 3, 1889.

Bluff Harbor, New Zealand; three males (16277). New Zealand; Otago Museum, one male (16284).

Found also in Australia.

Paramithrax edwardsii (de Haan).

Maja (Paramithrax) edwardsii de Haan, Fauna Japonica, p. 92, pl. XXI, fig. 2, 1839.
Paramithrax edwardsii Adams and White, Voy. Samarang, p. 14, 1848.
Paramithrax (Leptomithrax) edwardsii Miers, Ann. Nat. Hist. (4), XVII, p. 220, 1876.

Japan; H. Loomis; two males (16272).

Miers places this species in the subgenus *Leptomithrax*. The chelipeds, however, are not greatly elongated nor the palm subcylindrical. The carpus is similar in shape to those of *peronii* and *latreillei*, has two ridges, and is spinulous. In the larger specimen the fingers meet along their inner edges when closed; in a specimen about one and a half inches long, they are gaping at base, with a tooth on the dactyl. Our specimens of *longimanus* and *australis* have fingers gaping at base. This, therefore, can not constitute a subgeneric character. *Edwardsii* is allied also by the form of its carapace to the subgenus *Paramithrax*, in which the caparace is oblong ovate, while in *Leptomithrax* the carapace is triangular-ovate. In *edwardsii* the eyes reach the postocular spine, as in *Leptomithrax*.

Paramithrax latreillei Miers.

Paramithrax barbicornis Miers (not Latreille), Ann. Mag. Nat. Hist., (4), XVII, p. 219, 1876 (Cat. Crust. N. Z., p. 6, pl. I, fig. 2, 1876); Ann. Mag. Nat. Hist., (5), IV, p. 8, 1879. Haswell, Proc. Linn. Soc. N. S. W., IV, p. 440, 1879; Ann. Mag. Nat. Hist., (5), V, p. 146, 1880; Cat. Austral. Crust., p. 13, 1882.
Paramithrax latreillei Miers, Ann. Mag. Nat. Hist., (4), XVII, p. 220, 1876.
Paramithrax cristatus Filhol, Bull. Soc. Philom., IX, p. 26, 1885; (Rec. Venus, III, Abth. 2, p. 358, 1886).

Filhol (Bull. Soc. Philom.) shows that the specimens which in 1876 Miers referred to *barbicornis* are not identical with that species, and proposes for them the name *cristatus*, apparently not aware that Miers, in his preliminary description (Ann. Mag. Nat. Hist. (4), XVII, p. 219, 1876), designates the species as *latreillei*, if it should prove distinct from Latreille's *barbicornis*.

New Zealand; Otago Museum; two males (16283).

Paramithrax sternocostulatus A. Milne Edwards (*teste* Miers).

Paramithrax sternocostulatus A. Milne Edwards. Miers, Ann. Mag. Nat. Hist. (5), IV, p. 9, 1879. Haswell, Proc. Linn. N. S. W., IV, p. 440, 1879; Ann. Mag. Nat. Hist. (5), V, p. 146, 1880; Cat. Austral. Crust., p. 13, 1882.
Paramithrax gaimardii Miers (not Milne Edwards), Cat. Crust. N. Z., p. 6, 1876.

Port Jackson, Australia; Australian Museum, Sydney; male and female (17013).

Found also in New Zealand.

Paramithrax (Leptomithrax) australis (Jacquinot).

Maia australis Jacquinot, in Jacquinot and Lucas, Voy. au Pole Sud, Zool., III, Crust., p. 11, 1853.
Paramithrax (*Leptomithrax*) *australis* Miers, Ann. Mag. Nat. Hist. (4), XVII, p. 220 1876; (Cat. Crust. N. Z., 1876).

One male specimen has been received from the Otago University Museum, Dunedin, New Zealand (16285). It is 93 millimeters long from the tip of the rostrum and 82.5 wide, without spines. The chelipeds are extremely long, about 223 millimeters; the hands are very long and strong.

Paramithrax (Leptomithrax) longimanus Miers.

Ann. Mag. Nat. Hist., (4), XVII, p. 220, 1876; (Cat. Crust. N. Z., 1876); Jour. Linn. Soc. London, XIV, p. 656, 1879.

Dunedin, New Zealand; Otago Museum; three males (16282).

The specimens do not agree exactly with Miers's description. Midway on the margin of the branchial region is a short, stout, blunt spine curved forward. The carapace is tuberculous rather than granulous. The length of the rostrum is only a little greater than half the width between the præorbital angles. Merus and carpus of cheliped tuberculous; manus conspicuously granulous inside, minutely so outside.

Chlorinoides longispinus (de Haan).

Maia (Chorinus) longispina de Haan, Fauna Japonica, p. 94, pl. XXIII, fig. 2, 1839.
Chorinus longispinus White, Crust. Brit. Mus., p. 123, 1847. Adams and White, Voy. Samarang, p. 12, 1848.
Chlorinoides longispinus Miers, Challenger Rept., Zoöl., XVII, p. 53, 1886.

Enoshima, Japan; P. L. Jouy (12345). Japan; H. Loomis (16274).

Chlorinoides spatulifer (Haswell).

Paramithrax spatulifer Haswell, Proc. Linn. Soc. N. S. W., VI, p. 540, 1881; Cat. Austral. Crust., p. 14, 1882. Miers, Crust. Alert., p. 194, 1884.
Chlorinoides spatulifer Miers, Challenger Rept., Zoöl., XVII, p. 52, 1886.

Port Stevens, Australia; Australian Museum, Sydney; one female (17014).

Pisa tetraodon (Pennant).

Cancer tetraodon Pennant (British Zoölogy, IV, pl. VIII, fig. 15).
Pisa tetraodon Leach, (Malac. Podoph. Brit., pl. 20, 1815). Milne Edwards, Hist. Nat. Crust., I, p. 305, pl. XIV bis, fig. 1, 1834, and synonymy. Bell, Brit. Crust., p. 22, 1853. Carrington and Lovett, Zoölogist (3), V, p. 358, 1881. Miers, Challenger Rept., Zoöl., XVII, p. 54, 1886. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 49, 1889.

Weymouth; A. M. Norman (6329). Channel Islands; Edward Lovett (6549). Locality unknown (16278).

Found also in the Mediterranean, Portugal, the Azores, and Teneriffe, 50 to 90 fathoms, and at Aden.

Pisa (Arctopsis) tribulus (Linné).

? *Cancer tribulus* Linné (Syst. Nat., ed. 12, p. 1045, 1766).
Pisa gibbsii Leach, Trans. Linn. Soc., XI, p. 327, 1815. Carrington and Lovett, Zoölogist (3), V, p. 360, figs. 1 and 2, 1881.
Pisa (Arctopsis) tribulus Miers, Challenger Rept., Zoöl., XVII, p. 55, 1886, and synonymy.

Channel Islands; Edward Lovett (6532). Guernsey; A. M. Norman (6315).

Found in the Mediterranean to 75 fathoms, and ranging to the Cape Verde Islands, 38 fathoms.

LEPTECES, gen. nov.

Carapace subpyriform or triangulate, slightly convex, tuberculous. Præocular spine present. Rostral horns divergent. Orbits with two hiatuses above and one below. Abdomen in both sexes seven jointed. Antennæ with a spine at the antero-external angle of the basal joint, the flagellum visible in a dorsal view at the sides of the rostrum. Exterior maxilliped with the antero-external angle produced and rounded, the inner angle notched. Chelipeds more slender than the ambulatory legs; palms very long and slender; fingers meeting along their inner edges. Ambulatory legs of moderate length, the anterior pair much the longer; joints spinous.

Lepteces ornatus, sp. nov.

Plate VI, Fig. 1.

Entire surface, except the hands, granulous. Carapace ornamented with tubercles of two kinds; first and most prominent, raised mushroom-like tubercles, each surmounted by a flat, circular disk, granulous and spinulous on the margins. Tubercles of this character, with disks overlapping, surround the cardiac region and outline the inner margin of the branchial region; there is one on the posterior edge of the gastric, four follow the postero-lateral margin, two are arranged transversely on the intestinal region, while a line of four runs almost transversely across each hepatic region and up on the gastric. There are many additional smaller tubercles of this character. The second variety of tubercle is smaller, but slightly more elevated than the first, spheroidal at the summit, granulous, and surmounted by a few long hairs. There are four such tubercles on the gastric region, two of which are on the median line, six on the branchial region, two or three on the cardiac region, and three on the posterior margin. The entire surface between and beneath the raised tubercles is crowded with stellar granules, varying in size.

The rostrum is composed of two regularly tapering, divergent spines, with long hairs, especially on the inner margins. Præocular spine strongly curved upward, at an angle of about 45° with the rostrum; acute, bearing a few long hairs near the tip.

Basal joint of antenna with the outer margin convex and tuberculous; a stout spine at the antero-lateral angle, pointing forward. Flagellum exceeding the rostrum. Posterior margin of the epistome directed abruptly backward near the center, then turning again almost transversely to form a shallow V at the median line. The depressions between the abdominal segments in the male are continued in grooves on the sternum.

Chelipeds in both sexes weak, slender, much shorter than the first pair of ambulatory legs; merus strongly and irregularly tuberculose; carpus feebly so; hands smooth, extremely slender, tapering to the fingers, which are in contact; prehensile edges finely dentate. Ambulatory legs stout, somewhat angled; anterior pair much the longest, armed with an irregular row of long spines above, a series of shorter spines on the inferior outer margin, and a few scattered spines. Proximal half of dactyls spinulose, extremities horny.

Length, including rostrum, 17; width, 9 millimeters.

Two males and six females of this unique form were collected by the U. S. Fish Commission steamer *Albatross* off Arrowsmith Bank, Yucatan, lat. 20° 59′ 30″ N., long. 86° 23′ 45″ W., 130 fathoms, coral, station 2354, 1885 (9546).

Hyastenus diacanthus (de Haan).

Pisa (*Naxia*) *diacantha* de Haan, Fauna Japonica, p. 96, pl. XXIV, fig. 1, and pl. G, 1839.
Naxia diacantha White, Crust. Brit. Mus., p. 6, 1847. Adams and White, Voy. Samarang, Crust., p. 10, 1848. Stimpson, Proc. Acad. Nat. Sci. Phila., IX, p. 218, 1857. Heller, Reise Fregatte Novara, II, 3, p. 3, 1868. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 51, pl. II, fig. 5, 1889.
Hyastenus diacanthus A. Milne Edwards, Nouv. Archiv. du Mus., VIII, p. 250, 1872. Miers (Cat. Crust. N. Z., p. 9, 1876; Proc. Zoöl. Soc. London, p. 26, 1879; Crust. Alert, pp. 194, 182, 1884; Challenger Rept., Zoöl. XVII, pp. 56, 57, 1886. Haswell, Proc. Linn. Soc. N. S. Wales, IV, p. 442, 1879; Cat. Austral. Crust., p. 20, 1882. Walker, Jour. Linn. Soc. London, XX, p. 109, 1887. De Man, Arch. f. Natur., LIII, p. 220, 1887. Cano, Boll. Soc. Nat. Napoli (1), III, p. 178, 1889.
Hyastenus verreauxii A. Milne Edwards, loc. cit.

Japanese seas; U. S. S. *Palos*; two females (16288, 16289).
Japan; H. Loomis; three males, five females (16273).
Sydney Harbor, New South Wales; William E. Langley (5740).
Distributed throughout the Indo-Pacific region.

Hyastenus caribbæus, sp. nov.

Plate VI, Fig. 2.

Carapace triangular-ovate, with a stout spine on the summit of the posterior portion of the branchial region, and another on the intestinal region just above the posterior margin. Regions distinct. There are three inconspicuous tubercles on the gastric, and one at the inner angle of each branchial region. Carapace covered with a short, close pubescence, with scattered bunches of hair. Rostrum nearly as long as the carapace, entire for about one-fourth its length; horns slender, slightly divergent; margins hairy. Basal antennal joint without a spine. Flagellum not so long as the rostrum.

Chelipeds slender, unarmed; merus subcylindrical; manus long, compressed, narrowest near the carpus, widening slightly to the base of the fingers; dactyl arched, with a tooth near the base; fingers gaping at the base when closed. Ambulatory legs very slender, the first pair longer than the chelipeds.

Length of carapace, exclusive of rostrum, 13; width, 10.5; length of rostrum, 9.5; length of cheliped, about 24 millimeters. A specimen with a total length of 14 millimeters has comparatively a much shorter rostrum and spines than the one described above.

Sabanilla, United States of Colombia; U. S. Fish Commission steamer *Albatross*, 1884; two males (16315). This is the first species of *Hyastenus* recorded from the Atlantic Ocean.

Hyastenus longipes (Dana).

Plate [illegible].

Chorinus longipes Dana, Amer. Jour. [illegible] p. 269, [illegible]; Crust. [illegible] Expl. Exped., [illegible] pl. [illegible], fig. 5, 1852. [illegible] Boston [illegible] Nat. Hist. [illegible] p. [illegible] [illegible] [illegible]
Hyastenus [illegible] *longipes* [illegible] Jour. Linn. Soc. London [illegible] p. [illegible]; Proc. Zoöl. Soc., London, p. [illegible]

Hyastenus japonicus Miers, Proc. Zoöl. Soc. London, p. 27, pl. I, fig. 2, 1879; Challenger Rept., Zoöl., XVII, p. 56, 1886.
Hyastenus longipes Miers, Challenger Rept., Zoöl., XVII, p. 56, 1886.

This species ranges from 57° north latitude, off Kadiak, Alaska, to 32° north latitude, off San Diego, Cal., and in depth from 27 to 603 fathoms. It exhibits wide variations from Dana's types, especially in more southern latitudes, where, as a rule, the carapace is very much swollen at the branchial regions, making the width much greater in proportion to the length; the second and third joints of the antennæ are much more slender; the hepatic region is furnished with a sharp spine; and, lastly, the tubercles of the carapace are more numerous and some of them spinous. These characteristics, if uniform, would be specific, but the two extremes intergrade to such an extent as to render impossible even a varietal separation. The broad form is with one exception confined to deep water; the typical *longipes* ranges from 27 fathoms in the north to 456 in the south. Variations exist in specimens from the same locality; for example: The broad forms may possess a hepatic spine or a tubercle; the antennal joints are narrow in some individuals and wide in others. Occasional specimens of the narrow form have a sharp hepatic spine. An examination of the branchiæ of the broad and narrow forms shows that they are larger in the former. Corresponding differences exist in the size of the maxillipeds, the flabella being larger, as well as the scaphognathite of the second maxilla. The endopodite of the first maxilliped, however, which is seen to be so different in the two species of *Chionœcetes*, is the same size and shape in the two forms of *Hyastenus longipes*.

The width of the typical form ranges from 0.71 to 0.8 of its length; of the wider form, from 0.82 to 0.9 of its length; the length being measured from between the bases of the cornua. The measurements are taken of male specimens, with one exception. In the following tables the stations are arranged from north to south:

Table of measurements.

Station.	Length of carapace.	Width of carapace.	Proportion of length to width.
	mm.	*mm.*	
2862	21	15	1: .71
2862	25.5	19	1: .74
2882	33	25	1: .76
3112	20	15	1: .75
3112	28	21.5	1: .77
3112	19.5	15	1: .77
3114	18	14	1: .78
3126	27	21.5	1: .8
2960	35	28	1: .8
2979	46	41.5	1: .9
2896 ♀	23	18	1: .78
2896	18	13	1: .72
2980	29	24	1: .83
2980	35.5	30	1: .84
2936	53.5	46	1: .86
2936	55.5	50	1: .9
2928	47	40	1: .85
2927	31.5	26	1: .82
2927	38	31.5	1: .83
2934	28.5	23.5	1: .82

RECORD OF SPECIMENS EXAMINED.

From Kadiak to San Diego; U. S. Fish Commission steamer *Albatross*, 1888–1891:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom.			Date.	Remarks.
				Fath.	Temp.	Materials.		
		° ′ ″	° ′ ″		°			
15496	2855	57 00 00	153 18 00	69	44	gn. M.......	Aug. 10	Typical form.
15497	2862	50 49 00	127 36 30	238	44.7	gy. S. P.....	Sept. 1	Do.
15495	2877	48 33 00	124 53 00	59	45.5	bk. S. M	Sept. 25	Do.
15499	2874	48 30 00	124 57 00	27	50.3	R. Sh	Sept. 24	Do.
17081	3449	48 29 40	124 40 10	135	....	gy. S. G.....	Aug. 28	Do.
17085	3454	48 27 50	124 42 40	152	44.2	gy. S. rky...	Sept. 1	Do.
17083	3451	48 25 10	124 37 50	106	45	G. St........	Aug. 28	Do.
17086	3450	48 24 20	124 24 40	123	44.5	gy. S. P.....	Sept. 2	Do.
17088	3466	48 18 30	123 22 00	56	48.5	gy. S.Sh. rky	Sept. 2	Do.
17080	3445	48 16 00	123 45 05	100	44	rky	Aug. 27	Do.
15494	2865	48 12 00	122 49 00	40	51.7	P	Sept. 6	Do.
15498	2882	46 09 00	124 22 30	68	45.8	gy. S........	Oct. 13	Do.
17626	3085	44 29 30	124 17 00	42	46	fne. gy. S....	Sept. 2	Do.
16776	2889	43 59 00	124 56 00	46	47.7	C. Sh	Oct. 19	Typical form, but with hepatic spine.
16030	3350	38 58 10	123 57 05	75	48.4	fne. S. M....	Sept. 25	Typical form.
15515	3112	37 08 00	122 47 00	296	41.8	fne. gy. S ...	Mar. 12	Do.
15512	3114	37 06 00	122 32 00	62	....	M	Mar. 12	Do.
15514	3205	36 55 10	122 23 50	240	43.7	bk. S. R	Apr. 12	Do.
15516	3126	36 49 20	122 12 30	456	52.8	gn. M.......	Mar. 13	Intermediate in width, otherwise typical.
16777	3187	36 14 00	121 58 40	298	41.1	yl. S. M.....	Apr. 3	Typical form.
15511	3193	35 25 50	121 09 10	160	44.4	gn. M......	Apr. 5	Do.
15596	2893	34 12 30	120 32 30	145	48.6	fne. gy. S.M.	Jan. 5	Do.
15508	2960	34 10 45	120 16 45	267	48	gn. M.......	Feb. 9	Intermediate in width, otherwise typical.
15507	2956	33 57 30	120 18 30	52	53.1	fne. gy. S. R.	Feb. 8	Typical form.
16031	2979	33 56 30	119 22 30	388	....	gn. M.......	Feb. 12	Broad form.
15509	2896	33 55 30	120 28 00	376	42.8	yl. M.	Jan. 6	Typical form.
15502	2980	33 49 45	119 24 30	603	38.9	gn. M.......	Feb. 12	Broad form; 9 specimens with hepatic spine, 1 without.
15510	2982	33 24 45	119 07 00	178	46.7	S. M. G.....	Feb. 13	Broad form.
15505	2937	33 04 30	117 42 00	464	46.5	gn. M.......	Feb. 4	Do.
15501, 15500	2936	32 49 00	117 27 30	359	49	M	Feb. 4	Broad form. Second article of antenna wide in some specimens.
15504	2928	32 47 30	118 10 00	417	41	bk. S. G	Jan. 23	Do.
15503	2927	32 43 00	117 51 00	313	43.3	gn. M.......	Jan. 23	Broad form. Some specimens with hepatic tubercle.
15506	2934	32 33 30	117 16 00	36	58.2	gy. S	Jan. 26	Do.

Hyastenus japonicus Miers (*loc. cit.*) is apparently identical with *longipes*, as the length and divergence of the rostral spines, the length of the antennal spines, and the spines on the merus are variable characters in *longipes*.

Hyastenus, sp.

Two small and immature specimens from Lower California have been referred to this genus. The species is distinct from *longipes*, but its characters can not be distinctly determined without larger and more numerous specimens. The surface is pubescent. As in *longipes* the carapace is tuberculous and spinulous, but broader anteriorly. The epibranchial spine is slender. There is a prominent hepatic spine as in the southern form of *longipes;* the postorbital spine is slender and between it and the hepatic spine there is a shorter subhepatic spine visible from above. Præorbital spine present. The front is broader than in *longipes*, the slender rostral horns not so divergent, fringed with long hairs on the inner margin. Basal antennal joint with a slender

spine at the antero external angle, and a spinule further back on the margin. The larger specimen, a female, has slender chelipeds; merus and carpus spinuliferous, as is also the manus on the upper margin near the carpus. Ambulatory legs slender; meral joints spinulous above, dactyli spinulous beneath.

Length, including rostrum, 8; width 4.5 millimeters. The smaller specimen is only 5 millimeters long.

Lat. 24° 58′ 15″ N., long. 115° 53′ W., 36 fathoms, temperature 64.3°, coralline; station 2989, U. S. Fish Commission steamer *Albatross*, 1889 (17380).

Naxia robillardi Miers.

Proc. Zoöl. Soc. London, p. 339, pl. XX, fig. 1, 1882; Challenger Rept., Zoöl., XVII, pp. 60, 61, 1886; Pocock, Ann. Mag. Nat Hist. (6), V, p. 79, 1890.

Mauritius; H. A. Ward; one female (16316). This species has been taken, at 30 fathoms, off Mauritius.

Scyra acutifrons Dana.

Amer. Jour. Sci. (2), XI, p. 269, 1851; Crust. U. S. Expl. Exped., I, p. 95, pl. II, fig. 2, 1852. Stimpson, Jour. Boston Soc. Nat. Hist., VI, p. 455, 1857; Lockington, Proc. Cal. Acad. Sci., VII, p. 69, 1876. Miers, Jour. Linn. Soc. London, XIV, p. 663, 1879; Challenger Rept., Zoöl., XVI, p. 62, 1886. Smith, Rept. Geol. Survey Canada for 1878-'79, p. 210 B (1880).

A large series of specimens serves to confirm Prof. Smith's supposition that Dana's description was based on immature individuals. In large males the carapace is very nodulous, the rostrum wide, and the chelipeds strongly developed. In females the regions are much less elevated, the gastric region evenly rounded, without tubercles.

RECORD OF SPECIMENS EXAMINED.

Kadiak, Alaska; W. G. W. Harford (14801).
Victoria, B. C.; Dr. C. F. Newcombe (15793).
Port Orchard, Puget Sound; O. B. Johnson (14966).
Puget Sound; D. S. Jordan (3099).
Monterey, Cal.; D. S. Jordan (16291); Dr. Canfield (3449).
Southern California; W. H. Dall (16290).
From Vancouver Island to Santa Barbara, Cal.; U. S. Fish Commission steamer *Albatross*, 1888-1890:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom. Fath.	Bottom. Temp.	Bottom. Materials.	Date.
		° ′ ″	° ′ ″		°		
16344	2881	49 00 00	125 48 00	24	52.3	gy. S	Sept. 26
16343	2879	48 53 00	125 53 00	34	50.3	Rocks	25
16020	2874	48 30 00	124 57 00	27	50.3	R. Sh	24
15513	3124	36 55 10	122 04 00	21	52.3	rky	Mar. 13
16341	2961	34 22 45	119 40 30	21		gn. M	Feb. 11
16342	2969	34 20 40	119 37 45	26	58.0	gy. S. P. St	11

Following out the suggestion of Mr. Miers, I have placed *Scyra umbonata* Stimpson among the Inachidæ.

Eurynome aspera (Pennant).

Cancer asper Pennant (Brit. Zoöl., IV, t. X, f. 3, p. 13).
Eurynome aspera Leach (Malac. Brit., t. XVII, 1815). Guérin, Icon. Règne Anim., II, pl. VII, fig. 4. Milne Edwards, Hist. Nat. Crust., I, p. 351, pl. XV, fig. 18, 1834, and synonymy. Bell, Brit. Crust., p. 46, fig., 1853. Miers, Jour. Linn. Soc. London, XIV, p. 659, 1879. Carrington and Lovett, Zoölogist (3), V, p. 418, 1881. Scott, 6th Ann. Rept. Fishery Board for Scotland, pt. III, p. 256, 1888. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. XXIII, 1, p. 51, pl. I, figs. 7, 8, 1889. Cano, Boll. Soc. Nat. Napoli (1), III, p. 178, 1889. Osorio, Jor. Sci. Lisboa (2), I, p. 53, 1889.
Eurynome spinosa Hailstone, Mag. Nat. Hist., VIII, pp. 519, 638, 1835.

Guernsey: A. M. Norman (6314). Channel Islands: Edward Lovett (6567).

Recorded from the British Isles, France, and the Mediterranean.

Pelia mutica (Gibbes).

Pisa mutica Gibbes, Proc. Amer. Assoc. Adv. Sci., III, p. 171, 1850.
Pelia mutica Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 177, 1860. Smith, Rept. U. S. Commr. of Fisheries for 1871 and 1872, p. 548 (1874). A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 73, pl. XVI, fig. 2, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 385, 1879.

I find this species extremely variable in the divergence of the rostrum and in the antero-external angle of the basal joint, which is sometimes unarmed and sometimes armed with a small spine. The species ranges from Vineyard Sound to the west coast of Florida, and the more northern specimens, that is, from Vineyard Sound to Beaufort, are those most likely to present the antennal spine, while the southern forms have usually a blunt angle at that point. There is no constancy in this occurrence, however, and no accompanying characteristic that is invariable.

RECORD OF SPECIMENS EXAMINED.

Vineyard Sound, Mass., low water to 12 fathoms; U. S. Fish Commission.
Virginia (Union College Coll.).
Beaufort, N. C. (Union College Coll.).
Calibogue Sound, S. C.; U. S. Fish Commission (16350, 16773).
Florida:
  Florida Bay (Union College Coll.).
  Marco; H. Hemphill (16999).
  Charlotte Harbor; W. H. Dall (17002).
  Sarasota Bay; H. Hemphill (16208).
  Goodland Point; H. Hemphill (17000).
  Cedar Keys; Lieut. J. F. Moser, U. S. Navy (16207); H. Hemphill (6419), on coral, one fathom (17001).

Pelia rotunda A. Milne Edwards.

Miss. Sci. au Mexique, Pt. 5, I, p. 74, pl. XVI, fig. 4, 1875.

Two males from off the Rio de la Plata, one in lat. 36° 42′ S., long. 56° 23′ W., 11½ fathoms, sand, broken shells, station 2764, U. S. Fish Commission steamer *Albatross*, 1888 (16347), and the other in lat. 36° 47′ S., long. 56° 23′ W., 10½ fathoms, sand, broken shells, station 2766 (17321).

A. Milne Edwards records this species in the text as *rotunda*, while in the description of the figure it is designated as *rotundata*. The types are from off Patagonia and Brazil.

In characterizing the two specimens at hand, I have compared them with specimens of *mutica* of equal length from South Carolina, and have made the following observations: The width at the branchial regions is the same, but *rotunda* is wider at the hepatic regions. The gastric and cardiac regions are a little more swollen in this species. The rostrum is the same length in both species, but in *mutica* the horns are strongly divergent, while in *rotunda* the outer margins are subparallel. The rostrum is more deflexed and wider at the base in *rotunda* and there is a corresponding width underneath across the basal antennal joints. The fingers do not differ essentially from those of *mutica*. It is very probable that a large series of specimens of *rotunda* would show that the above-mentioned characters are not constant, but offer individual variations as in *mutica*.

Pelia pacifica A. Milne Edwards.

Miss. Sci. au Mexique, Pt. 5, I, p. 73, pl. XVI, fig. 3, 1875.

RECORD OF SPECIMENS EXAMINED.

California:
  Catalina Harbor; W. H. Dall (16204).
  Southern California; W. H. Dall (16203); many specimens.
  San Diego, 10 fathoms; H. Hemphill (6385). C. R. Orcutt (16205, 16206); Rosa Smith (16998).
Gulf of California; U. S. Fish Commission, 1889:
  Off Adair Bay, Mexico, lat. 31° 22′ N., long. 114° 07′ 45″ W., 17 fathoms, gravel, broken shells, temperature 65.2°, station 3026 (16349); one female, with rostral horns a little more divergent than in typical specimens, but otherwise corresponding.

The types are from the Bay of Panama.

Pelia, sp.

Much like *pacifica*. The single male specimen, however, has chelipeds very strongly developed. Manus wide and swollen, fingers arched. The first ambulatory leg is longer than in *pacifica*, the merus joint nearly reaching the extremity of the rostrum; the penult joint is longer and more slender than in *pacifica*. The rostrum has its horns converging, but is deformed, as the two sides are of unequal length.

Off Magdalena Bay, Lower California, lat. 24° 58′ 15″ N., long. 115° 53′ W., 36 fathoms, coralline, temperature 64.3°; station 2989, U. S. Fish Commission steamer *Albatross*, 1889 (16348).

Nibilia erinacea A. Milne Edwards.*

Herbstia Schramm (Crust. de la Guadéloupe, p. 17, pl. VII, fig. 23, 1867).

Nibilia erinacea A. Milne Edwards, Miss. Sci. au Mexique, Pt. 5, I, p. 133, pl. XXV, 1878. Smith, Rept. Commr. of Fisheries for 1885, p. 627 (1887).

**Nibilia armata* A. Milne Edwards belongs properly among the Inachidæ.

RECORD OF SPECIMENS EXAMINED.

Off Cape Hatteras, N. C., and Gulf of Mexico; U. S. Fish Commission steamer *Albatross*, 1884–1885:

Cat. No.	Station.	Lat. N.	Long. W.	Bottom			Date.	Sex.	
				Fath.	Temp.	Materials.		♂	♀
		° ′ ″	° ′ ″		°				
7256	2301	35 11 30	75 05 00	59	75	crs S. bk. Sp	Oct. 21	1	1
14691	2595	35 08 00	75 05 30	63	....	gy. S. brk. Sh	17	1	1*
9688	2386	29 15 00	88 06 00	60	61.8	bu. M	Mar. 4	1 young.	

*With eggs.

Recorded from the Caribbean Sea.

Schizophrys aspera (Milne Edwards).

Mithrax asper Milne Edwards, Hist. Nat. Crust., I, p. 320, 1834. Dana, Crust. U. S. Expl. Exped., I, p. 97, pl. II, fig. 4, 1852.

Maja (Dione) affinis de Haan, Fauna Japonica, Crust., p. 94, pl. XXII, fig. 4, 1839. Adams and White, Voy. Samarang, p. 15, 1848. Stimpson, Proc. Acad. Nat. Sci. Phila., IX, p. 218, 1857.

Schizophrys serratus White, Crust. Brit. Mus., p. 9, 1847; Proc. Zoöl. Soc., London, XV, p. 223, fig., 1847; Ann. Mag. Nat. Hist. (2), II, p. 283, fig., 1848. Adams and White, op. cit., p. 16.

Schizophrys spiniger White, loc. cit. Adams and White, op. cit., p. 17.

?? *Mithrax quadridentatus* Mac Leay, in Smith, Annulosa, Zoöl. South Africa, p. 58, 1849.

Schizophrys affinis Stimpson, Amer. Jour. Sci., XXIX, p. 133, 1860.

Schizophrys aspera Stimpson, loc. cit. A. Milne Edwards, Nouv. Arch. Mus. Hist. Nat., VIII, p. 231, pl. X, figs. 1–1 f, 1872. Miers, Jour. Linn. Soc. London, XIV, p. 660, 1879; Crust. H. M. S. Alert, p. 197, 1884; Challenger Rept., Zoöl., XVII, p. 67, 1886. Haswell, Proc. Linn. Soc. N. S. W., IV, p. 447, 1879; Ann. Mag. Nat. Hist. (5), V, p. 147, 1880; Cat. Austral. Crust., p. 22, 1882. De Man, Jour. Linn. Soc. London, XXII, p. 20, 1887; Archiv für Natur., LIII, p. 226, 1887. Walker, Jour. Linn. Soc. London, XX, p. 113, 1887. Aurivillius, op. cit., p. 51. Cano, op. cit., p. 179.

Schizophrys serrata Stimpson, loc. cit.

Schizophrys spinigera Stimpson, loc. cit.

Mithrax spinifrons A. Milne Edwards, Ann. Soc. Entom. France (4), VII, p. 263, 1867.

Mithrax affinis Capello, Jor. Sci. Lisboa, p. 264, pl. IIIa, fig. 4, 1871.

Mithrax (Schizophrys) triangularis Kossmann, (Crust. Reise Küsten. Rothen Meeres, pp. 11, 13, 1887).

M. (S.) triangularis var. *africanus* Kossmann, (op. cit., pp. 11, 14).

M. (S.) triangularis var. *indicus* Kossmann, (loc. cit.).

Japan; H. Loomis; four males and one female (16319) of the typical form, and corresponding to the figure by de Haan.

Samoa; H. A. Ward; one male and one immature female (16318) of the variety *spinifrons* (A. Milne Edwards).

This species is widely distributed throughout the Indo-Pacific region.

Pseudomicippa ? varians Miers.

Ann. Mag. N. H., (5), iv, p. 12, pl. IX, fig. 8, 1879; Crust. Alert, pp. 182, 197, 1881; Challenger Rept., Zoöl., XVII, p. 68, 1886.

Port Jackson, Australia; Australian Museum; one female (17015).

Micippa mascarenica (Leach).

Micippa philyra Leach (not Herbst), Zoöl. Misc., III, p. 16, 1817. Guérin, Icon. Crust., pl. VIII BIS, fig. 1. Milne Edwards, Hist. Nat. Crust., I, p. 330, 1834. Adams and White, Voy. Samarang, p. 15, 1848. A. Milne Edwards, Nouv. Arch. Mus. Hist. Nat., VIII, p. 239, pl. XI, fig. 2, 1872. Richters, in Möbius (Meeresfauna Mauritius u. Seychellen, p. 143, pl. XV, figs. 6, 7, 1880). Miers, Crust. Alert, pp. 198, 182, 1884.

Micippa philyra var. *mascarenica* Kossmann, (op. cit., p. 7, pl. III, fig. 2). Lenz and Richters, Abh. Senck. Natur. Ges., XII, p. 421, 1881. Miers, op. cit., p. 525.

Micippa superciliosa Haswell, Proc. Linn. Soc. N. S. W., IV, p. 446, pl. XXVI, fig. 2, 1879; Ann. Mag. N. H. (5), V, p. 147, 1880; Cat. Austral. Crust., p. 25, 1882, var. Miers, op. cit., p. 199.

Paramicippa asperimanus Miers, op. cit., pp. 525, 517, var.

Micippa mascarenica Miers, Ann. Mag. Nat. Hist. (5), XV, p. 7, 1885; Challenger Rept. Zoöl., XVII, p. 69, 1886. Walker, Jour. Linn. Soc. London, XX, p. 109, 1887.

Mauritius; H. A. Ward; one male specimen of the typical form (16317). Length to base of rostrum, 18 millimeters; width, 16; length of rostrum, 9; length of cheliped, about 20; length of first ambulatory leg, about 22 millimeters.

Chelipeds smooth, covered with indistinct, light-colored spots. Palm slightly compressed, not dilated. Fingers with a very narrow hiatus at base when closed.

A common East Indian species.

Micippa spinosa Stimpson.

Micippa spinosa Stimpson, Proc. Acad. Nat. Sci. Phila., IX, p. 218, 1857. Haswell, Cat. Austral. Crust., p. 26, 1882. Miers, Ann. Mag. N. H. (5), XV, p. 8, 1885; Challenger Rept., Zoöl., XVII, p. 70, pl. VIII, fig. 2, 1886.

Paramicippa spinosa Miers (Cat. Crust. N. Z., p. 9, 1876); Crust. Alert, pp. 182, 199, 1884. Haswell, Proc. Linn. Soc. N. S. W., IV, p. 447, 1879; Ann. Mag. N. H. (5), V, p. 147, 1880.

Port Jackson, Australia; two males and two females; Australian Museum, Sydney (17016).

Inhabits New Zealand also.

Micippa thalia aculeata (Bianconi).

Pisa (*Micippa*) *thalia* de Haan, Fauna Japon., Crust., p. 98, pl. XXIII, fig. 3, and pl. G, 1839 (non *Cancer thalia* Herbst).

Micippa aculeata Bianconi (Mem. Accad. Bologna, III, p. 103, pl. X, fig. 2, 1851); Hilgendorf, Monats, K. Akad. Wiss. Berlin, p. 786, 1878.

Micippa haanii Stimpson, Proc. Acad. Nat. Sci., Phila., p. 217, 1857; de Man, Jour. Linn. Soc. London, XXII, p. 20, 1887.

Micippa thalia var. *aculeata* Kossmann, (Malac. in Zool. des R. Meeres, p. 8, pl. III, fig. 5, 1877); Miers, Ann. Mag. N. H. (5), XV, p. 11, 1885.

Micippa thalia var. *haani* Miers, Crust. *Alert*,, pp. 524, 517, 1884.

Japan; H. Loomis. Recorded also from Chinese Seas and Indian Ocean.

LIST OF SPECIES OF MAIIDÆ NOT REPRESENTED IN THE COLLECTION OF THE U. S. NATIONAL MUSEUM.

EASTERN ATLANTIC OCEAN.

Herbstia orata (Stimpson)........................Cape Verde Islands, 20 fathoms
rubra (A. Milne Edwards)........................Cape Verde Islands
violacea (A. Milne Edwards)........Cape Verde Islands; West Africa; etc.
eryophora Rochebrune........................Senegambia
bocagei Ozorio (*Fide* Archiv für Natur., II, 2, 1889)..........Eastern Atlantic
Maia goltziana Oliviera........................Portugal
Phycodes antennarius A. Milne Edwards........................St. Vincent
Pisa hirticornis (Herbst)............Mediterranean; Aden; also East Indies (Herbst)
carinimana Miers........................Canaries; Senegambia
Schizophrys dichotoma (Latreille). Mediterranean; also East Indies (Adams and White)

EAST COAST OF AMERICA.

Herbstia (*Herbstiella*) *depressa* (Stimpson).....St. Thomas, Brazil, 30 to 350 fathoms
Coelocerus spinosus A. Milne Edwards........................Florida, 19 fathoms
Oplopisa spinipes A. Milne Edwards........................Florida Straits, deep water
Pisa antilocapra Stimpson........................Off Florida, 52 to 118 fathoms
prælonga Stimpson........................Off Florida, 118 to 124 fathoms
erinacea A. Milne Edwards........................Florida Straits, 37 fathoms
Notolopas brasiliensis Miers........................Bahia, 7 to 20 fathoms
Rochinia gracilipes A. Milne Edwards..Cape Corrientes; mouth Rio Negro, 30 fathoms; near Patagonia, 44 fathoms.
Temnonotus granulosus A. Milne Edwards........................Barbados, 100 fathoms
simplex A. Milne Edwards........................Barbados, 100 fathoms

WEST COAST OF NORTH AMERICA.

Chorilibinia angusta Lockington........................Gulf of California
Herbstia pubescens Stimpson........................Manzanillo, Mexico
(*Herbstiella*) *tumida* (Stimpson)........................Manzanillo, Mexico
(*Herbstiella*) *parvifrons* Randall....West Coast of America, Cape St. Lucas
Notolopas lamellatus Stimpson........................Panama: Manzanillo

WEST COAST OF SOUTH AMERICA.

Chionœcetes chilensis Streets........................Chile
Herbstia pyriformis (Bell)........................Galapagos Islands
(*Herbstiella*) *edwardsii* (Bell)........................Galapagos Islands
Pisoides edwardsii Bell......Panama; Galapagos Islands; Chile; Straits of Magellan
Pelia pulchella Bell........................Galapagos Islands

EAST INDIAN REGION.

Egeria arachnoides (Rumph)..Australian, Indian, Malaysian, and Chinese seas, to 49 fathoms.
Chorilibinia gracilipes Miers........................N. and NE. Australia; New Guinea
Herbstia crassipes (A. Milne Edwards)........................Australia
Maia spinigera de Haan........................Japan; East Indies
miersii Walker........................Singapore
? *rosselii* Audouin........................Egypt
Paramithrax ursus (Herbst)........................"South Sea"
verrucosipes (Adams and White)........................Eastern seas
barbicornis (Latreille)........................Australia; New Holland

Paramithrax gaimardii Milne Edwards ... New Zealand
spinosus Miers ... Norfolk Island
minor Filhol ... Cook Strait, New Zealand
(*Leptomithrax*) *australiensis* Miers ... Tasmania
(*Leptomithrax*) *brevirostris* Miers ... Locality unknown
(*Leptomithrax*) *compressipes* Miers ... Canton
(*Leptomithrax*) *spinulosus* Haswell ... Tasmania; King George's Sound
Chlorinoides longispinus bituberculatus Miers ... Amirante and Providence groups, 19 to 22 fathoms
acanthonotus (Adams and White) ... Borneo
aculeatus (Milne Edwards) ... Seas of Asia
aculeatus armatus (Miers) ... N. and NE. Australia, 3 to 11 fathoms
halimoides (Miers) ... Oriental seas
coppingeri (Haswell) ... N. and E. Australia; Japan
tenuirostris (Haswell) ... Torres Strait
filholi (A. Milne Edwards) ... Stewart Island
Acanthophrys cristimanus A. Milne Edwards ... Noukahiva; Marquesas
paucispina Miers ... Ovalau, Fiji Islands
Pisa brevicornis A. Milne Edwards ... Madagascar
acutifrons A. Milne Edwards ... Zanzibar
Hyastenus aries (Latreille) ... Coromandel
spinosus A. Milne Edwards ... Archipel Viti; Mozambique
sebæ White ... Philippines; Amboina; Indian Ocean
planasius (Adams and White) ... Chinese Seas; N. and NE. Australia; Singapore.
pleione (Herbst) ... Oriental Seas; Mergui Archipelago
oryx A. Milne Edwards ... Philippines; Australia; New Caledonia; Singapore; Providence Island.
gracilirostris Miers ... Fiji Islands
ovatus (Dana) .. Sandwich Islands; African or Eagle Islands, 10 fathoms; Poivre Island or Isle des Roches.
sinope Adams and White ... China Sea; Philippine Islands
convexus Miers ... Port Molle, N. E. Australia, 14 fathoms
hilgendorfi de Man ... Mergui Archipelago
brockii de Man ... Amboina
tenuicornis Pocock ... China Sea, 25 to 30 fathoms
fascicularis (Krauss) ... Natal
Lepidonaxia defilippii Targioni-Tozzetti ... Java
Scyra compressipes Stimpson ... Japan, 6 to 50 fathoms
Naxia serpulifera Milne Edwards ... N. and W. Australia
hirta A. Milne Edwards ... East Africa; Indian Ocean
hystrix Miers ... Moluccas, Amboina, 100 fathoms
elegans (Miers) ... Near Ki Islands, 140 fathoms
taurus Pocock ... China Sea, 32 fathoms
Micippoides angustifrons A. Milne Edwards ... Fiji
longimanus Haswell ... Port Jackson, Australia
Eurynome longimana Stimpson ... Cape of Good Hope, 10 fathoms
erosa A. Milne Edwards ... Samoa
stimpsonii Miers ... Providence Reef, Mascarenes
Schizophrys dama (Herbst) ... ?W. Australia; ?America
Cyclax perryi Dana ... Pitts Island, Kingsmill Group
spinicinctus Heller ... Red Sea
(*Cyclomaia*) *suborbicularis* (Stimpson) ... Gaspar Straits
(*Cyclomaia*) *margaritata* A. Milne Edwards .. W. Australia; New Caledonia; Sandwich and Viti Islands.

Criocarcinus superciliosus Milne Edwards....................New Caledonia
Picroceras armatus A. Milne Edwards....................New Caledonia
Pseudomicippa nodosa Heller....................Red Sea
tenuipes A. Milne Edwards....................?Indian Ocean
Micippa cristata (Linné)..........Indo-Malaysian Seas; Philippine Islands; Java
philyra (Herbst)....................Indo-Pacific; Red Sea
thalia (Herbst) typical....................Indo-Pacific; Red Sea; Natal
thalia miliaris (Gerstæcker)....................Red Sea
spinosa affinis Miers..Bass Strait; East Moncœur Island; New Zealand to 38 fathoms.
curtispina Haswell....................N. and NE. Australia; Singapore
Paramicippa tuberculosa Milne Edwards....................S. Australia

EXTRACT FROM AN UNPUBLISHED REPORT OF DR. WILLIAM STIMPSON, ON THE CRUSTACEA OF THE NORTH PACIFIC EXPLORING EXPEDITION, 1853 TO 1856.

Leptopus longipes (Herbst) Latreille.*

Cancer longipes Herbst (non Lin.).
Leptopus longipes Latreille; Guérin, Icon., pl. x, fig. 3.
Egeria herbstii Milne Edwards, Hist. Nat. des Crust., I, p. 292.
Egeria longipes Adams and White, Voy. Samarang, Crust., p. 7.

Among a large number of examples of this species collected by the expedition there are two adult males which differ so much in the size and character of the chelopoda from the specimens ordinarily found and those hitherto figured and described, that they might well be taken for a distinct species. The carapax of one of these specimens is 1 inch long and 0.85 inch broad. Proportion of breadth to length, 1 : 1.17. The chelopoda are large and robust, 1.8 inches in length. Hands much inflated; fingers gaping posteriorly; movable one with a large tooth at its inner base.

In nine-tenths of the male specimens taken, many of which are at least two-thirds as large as that above described, the hands are slender and weak, like those of the female; this (immature) form is that represented by Guérin's figure. In the sterile females, which occurred in equal numbers with the ordinary females and the males, the abdomen is flattened and only two-thirds as wide as the sternum.

In all of our specimens the præorbital tooth is very small; the orbits are interrupted above by two deep fissures, and below by one wide fissure divided into two by a small tooth. The projections of the carapax are rather tubercles than spines. In color, the body is light reddish above, mottled with white; below, white; feet, whitish annulated with red. The figure given by Milne Edwards in the "Règne Animal" is less characteristic of our specimens than that of Guérin.

Dredged in the Harbor of Hong Kong, China, on a muddy bottom, at the depth of 6 fathoms.

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* A synonym for *Egeria arachnoides* (Rumph.).—M. J. R.

Chionœcetes Behringianus Stimpson.*

Chionœcetes Behringianus Stimpson, Proc. Bost. Soc. Nat. Hist, VI, 84, Feb., 1857; Bost. Jour. Nat. Hist., VI, 449, 1857.

Peloplastus Pallasii Gerstæcker, Archiv für Naturgeschichte, XXII, 105, Taf. I, fig. 1.

Gerstæcker has given an excellent figure of this species in the Archiv für Naturgeschichte for 1856, but his paper does not appear to have been published before April, 1857; our name has therefore priority. The entomologist of Berlin does not seem to have been acquainted with Kröyer's genus *Chionœcetes*, to which the species certainly belongs; in fact it is most closely allied to the type *C. opilio*.

This species was found in Behring Straits, and northward as far as the expedition penetrated; many specimens having been dredged by Capt. Rodgers. It also occurred to southward of the straits, as far as Mativi Island. It is found only in deep water, and on bottoms more or less muddy. In a living state it was of a light brick-red color above, often iridescent; below, yellowish-white; sides of feet shining white. The posterior feet are short. The dimensions of the carapax of a large female are—length, 2.57; breadth, 2.72 inches.

In Gerstæcker's figure the surface of the carapax posteriorly, and the upper sides of the ambulatory feet, are represented as much more rugose than in any of our specimens.

Chionœcetes is evidently nearest allied to *Hyas*, although probably a higher form. In young specimens the resemblance to *Hyas* is easily noticed. *Hyas chilensis* should probably belong to it. It has considerable resemblance in general appearance to *Salacia* of the opposite extremity of the American continent, of which it may be considered the analogue.

Hyas latifrons Stimpson.†

Hyas coarctatus Stimpson (non Leach), Bost. Jour. Nat. Hist., VI, p. 450, 1857.

This species differs from *H. coarctatus* of the North Atlantic in the following characters, which are found to be constant upon examination of numerous specimens of both forms. The body is thicker and much broader anteriorly across the post-orbital apophyses; the angles are all more obtuse. The dorsal surface is marked with fewer tubercles, which are also much larger and more obtuse, most of them being rather swellings than warts. The rostrum is shorter and less acute; and the superior fissure of the orbit is always closed, its margins overlapping.

It is subject to considerable variation in some of its characters, particularly in the greater or less approximation of the forks of the rostrum, which may be so closely appressed against each other as to overlap, or may diverge so as to leave a narrow V-shaped space between. They diverge most in the young. The feet and inferior surface of the body are densely hirsute in some individuals and quite smooth in others.

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*Equivalent to *Chionœcetes opilio* (O. Fabricius).—M. J. R.

†See page 69.

The color is a dusky brick-red above; whitish below. The dimensions of a male from the Arctic Ocean, north of Bering Straits, are: Length of carapax, 2.85; greatest breadth, 2.12; greatest post-orbital breadth, 1.75; breadth at constriction, 1.59 inches.

This species was found by us in great numbers in all parts of the North Pacific Ocean north of the parallel of 50°. The following localities may be mentioned: Sea of Ochotsk; Avatscha Bay and off Cheponski Noss, coast of Kamtschatka; off Matwi Island; in Behring Straits, and in the Arctic Ocean. It occurred on all kinds of bottom, from low-water mark to a depth of 50 fathoms or more. Among several hundred specimens of this species, not one of *H. aranea* was found, although this latter species is said by Brandt to occur in the sea of Ochotsk.

The specimens from the waters of Avatscha Bay, which are somewhat brackish, do not differ from those taken in the open sea.

Brandt, in the Zoölogy of Middendorff's Reise in den Sibiriens, Part 1, page 78, describes a *Hyas* from the Sea of Ochotsk, which he considered a variety (*alutaceus*) of *H. coarctatus.* He states, however, that it differs from the Atlantic form in the somewhat more strongly granulated (stärker chagrinirte) upper surface of the carapax; in the broader posterior side of the body, and in the broader hands. These characters are certainly not those of our species, and for this reason we have not applied to the Pacific form the name *alutaceus.* In some of the larger specimens the surface is indeed granulated to some extent, particularly at the summits of the swellings; but specimens of ordinary size are always much smoother than any from the Atlantic. It is not impossible, therefore, that there is still another species in the North Pacific.

Genus **MICROPISA** Stimpson.*

It has been found necessary to institute a new genus for the reception of a small *Pisa*-like crustacean which was taken in considerable numbers at the Cape de Verde Islands. It has a short and broad ovate carapax and flattened rostrum. The orbits are much less complete than in *Pisa,* and have a single fissure above. It resembles *Scyra* in many respects, but the external antennæ are not concealed beneath the rostrum. The outer maxillipeds resemble somewhat those of *Pisa;* but the outer angle of the almost heart-shaped third joint is strongly projecting, and there is no notch for the reception of the fourth joint; the palpus is broad.

Micropisa ovata Stimpson.

Proc. Acad. Nat. Sci., Phila., IX, p. 217, 1857.

In this little crab the carapax is rather depressed, and but little longer than broad. The regions are sufficiently prominent, but generally smooth and rounded; there are, however, three inconspicuous pro-

*Not distinct from *Herbstia.*—M. J. R.

tuberances on the genital, and three on each branchial region. Surface pubescent, the more prominent portions often surmounted by a few curled setæ. The antero-lateral margin is swollen, but without teeth, except that immediately behind the postorbital tooth, and a small conical one at the lateral extremity of the branchial region. The chelopoda of the adult male are robust; the merus toothed along the angles; the hand smooth, somewhat compressed, and surmounted above by a ridge. Posterior four pairs of feet pubescent, the merus with a small tooth at the summit and one or two near the base. Length of carapax, 0.4; width, 0.38 inch.

Several specimens were taken in the harbor of Porto Praya, Cape de Verde Islands. They were dredged on a nullipore bottom at the depth of 20 fathoms.*

Micippa spinosa Stimpson.†

Body depressed; proportions of the carapax, breadth to length, as 1 to 1.3; upper surface uneven, crowdedly tuberculated and setose. Spines of the back few in number, but long and slender, with blunt extremities. There are three spines on the median line, two of which are on the gastric region, and one, the largest of all, on the cardiac. A large spine on each side on the branchial region, between which and the postorbital tooth on the lateral margin, there are nine spines, irregular in size and distance. Posterior margin spinulose, three or four spines near the middle being larger than the others. Rostrum inclined at an angle of 45° and bent at its extremity into the vertical plane; it is dilated at the extremity, the corners being broadly rounded and minutely crenulated; at the middle there are two diverging teeth. Ocular peduncles rather short, in length little more than twice their diameter. Orbit with two fissures above, the inner one closed, the outer open, separating the postorbital tooth. The pterygostomian (regions) are full convex, tuberculated, and not setose. The third joint of the outer maxillipeds is greatly expanded at its antero-exterior angle: the second joint is marked with a longitudinal furrow near its outer margin. The basal joint of the outer antennæ is very broad, its anterior tooth short, with nearly smooth margin; second joint oblong, compressed, with the margin ciliated with long hairs. Chelopoda equalling the carapax in length, smooth and glossy, fawn colored, with white bases; carpus and hand minutely and obsoletely granulated; fingers with black tips. Ambulatory feet compressed, thickly hairy, the merus with a small terminal spine above. Color of the body pale reddish, rendered indistinct by an accumulation of sordes retained by the setæ.

* A. Milne Edwards (Nouv. Arch. Mus. d' Hist. Nat., IV, p. 51, pl. XVI, fig. 1, 1868) represents this species with several unequal lateral teeth, and the ambulatory legs regularly tuberculose.—M. J. R.

† See page 92.—M. J. R.

Dimensions: Length of the carapax, 0.75; greatest breadth, 0.59; distance between tips of postorbital teeth, 0.45; length of first pair of ambulatory feet, 0.86 inch.

Specimens of this species were dredged on a muddy bottom in 6 fathoms in the harbor of Sidney or Port Jackson, Australia.

Micippa hirtipes Dana.*

Micippa hirtipes, Dana; U. S. Exploring Expedition, Crust. I, p. 90, pl. 1, fig. 4, 1852.

The following description is drawn up from specimens preserved in spirits; it may be useful, as Dana's specimens were dried: The body is moderately depressed; carapax minutely and somewhat unequally tuberculated above, without spines, except a small one at the branchial region on each side and a marginal one in front of this; these are continuous with the series of teeth on the antero-lateral margin. The posterior margin is denticulated with granular tubercles somewhat larger than those of the surface; the median two being larger and dentiform. The antero-lateral margin curves upward a little and shows nine minute teeth, two of which in the depression between the hepatic and branchial regions are much larger than the others. The superior margin of the orbit is two-fissured. The eye peduncles are exposed throughout their length and fully reach the tips of the teeth formed by the external angle of the orbit. Rostrum broader than long; its upper surface with two convex ridges; extremity broader than the base and four-toothed, the middle teeth being short, triangular, and blunt, the lateral ones sharp and curved upward. The movable part of the antennæ is at the base of the rostrum, separated from the orbit only by the narrow projecting terminal edge of the basal joint, which, seen from above, forms a slender tooth. Below the surface of this basal joint is smooth.

The upper surface of the body is hairy, the ambulatory feet densely so; hectognathopoda also hairy. First pair of ambulatory feet long. Dactyli much curved. The dimensions of a female specimen are as follows: Length of the carapax, 0.59; greatest breadth, 0.48 inch; proportion, 1:1.23; length of first pair of ambulatory feet, 0.64 inch.

Our specimens differ somewhat from Dana's figure in the greater prominence of the tooth of the basal joint of the antennæ, which projects so as to appear conspicuously above. The species is, however, undoubtedly the same. It approaches *M. philyra* in character, but is more hairy, the margins with smaller teeth, the teeth of the rostrum shorter and the outer ones recurved, and the movable part of the antenna not widely separated from the orbit. It has also some resemblance to *M. platipes* Ruppell, but has not the sharp terminal rostral teeth of that species.

Our specimens were taken at the islands of Loo Choo and Ousima. Those of the Exploring Expedition are from Tongatabu.

*A synonym of *Micippa philyra* (Herbst).—M. J. R.

Micippa Haanii Stimpson.*

The Japanese specimens of this species are said by De Haan to differ from the original specimens of *Cancer thalia* described by Herbst in wanting the two spines on the posterior margin of the carapax, and in having a spine on the merus of the ambulatory feet near its superior extremity. In all of our specimens from the Chinese Sea the characters are the same as those found in De Haan's figure and description, while none present the above-mentioned characters of *C. thalia*. Nor do they agree with the description of Herbst's specimen given by Gerstæcker in the Archiv für Naturgeschichte, vol. XXII, p. 109. Under these circumstances we have been led to consider the species distinct, and to propose a new name for De Haan's crustacean.

M. thalia Krauss, which inhabits the coast of South Africa, seems also distinct from the Herbstian species.

Naxia dicantha De Haan.†

In living specimens of this species the body is covered with sordes; when cleaned it is found to be of a yellowish-brown color above and below, the feet annulated with pale purplish-brown. There is a great diversity in the size of the hand and the shape of the fingers, shown between large males and those of ordinary or small size, as mentioned by De Haan.

The diversity in the shape of the rostrum in *Naxia serpulifera* and *N. dicantha* does not seem of sufficient importance to warrant a generic separation. The deep orbits, with peculiar fissures widening at the bottom, are characteristic of both; although in *N. dicantha* the inferior fissure is much broader than in the other species. There is, however, in the Japanese species a notch in the margin of the merus of the hectognathopod at the insertion of the carpus; while in *N. serpulifera*, judging from Guérin's figure, that margin is entire.

Naxia dicantha was taken by the expedition at the following localities: Hong Kong Harbor, abundant on shelly bottoms in 10 fathoms; northern China Sea in 20 fathoms; Kagosima Bay, Japan, in 20 fathoms, shelly bottom.

Scyra compressipes Stimpson.

Proc. Acad. Nat. Sci. Phila., IX, p. 218, 1857.

Carapax irregularly ovate, proportion of breadth to length 1:1.27 (rostrum and lateral spines included). It is rather depressed posteriorly, well contracted between the hepatic and branchial regions. Gastric region ample, rounded above, and nearly smooth, with the exception of two or three minute tubercles along the median line and

* Equivalent to *Micippa thalia aculeata* (Bianconi). See page 92.—M. J. R.
† See page 85.

one on either side posteriorly. There is a sharp tubercle on each side at the hepatic region, and a short, sharp spine, extending horizontally and somewhat curving forward, at the summit of each branchial region. Cardiac and intestinal regions rather small and only moderately elevated. Posterior margin with a slightly prominent tubercle at the middle. Rostrum scarcely as long as broad, laminiform, scarcely contracted at base; horns shorter and less acuminate than in *S. acutifrons.* Præorbital tooth prominent and acute, but rather short. Parts about the head below much as in *S. acutifrons.* The tooth forming the external angle of the orbit is deeply concave below, leaving the orbit at that point widely interrupted. Margin of the pterygostomian region with three small, obtuse, lobe-like teeth; a deep sinus separates this margin from that of the side of the carapax. Feet all much compressed. Merus of chelopoda four-sided or prismatic, obtusely tuberculated along the angles; superior edge with blunt teeth near the base, and one prominent sharp tooth near the extremity, being one of three large teeth surrounding the insertion of the carpus. Superior and inferior edges of ambulatory feet somewhat setose; the penultimate joints of these feet, however, are smooth and slender. In this and the other known species of the genus the setæ are stout and clavate in form. The dimensions of a sterile female are: Length of carapax, 0.65; greatest breadth, 0.51 inch.

This species was dredged in the Harbor of Hakodadi, Island of Jesso, Japan, on a bottom of weedy sand, at the depth of 6 fathoms.

Only one other species of the genus is known, *S. acutifrons* Dana, which inhabits the opposite coast of the North Pacific.

Dione affinis de Haan.*

The only specimen taken is young; the dimensions of the carapax being, length, 0.57; greatest breadth, 0.41; breadth between præorbital spines, 0.35 inch. Proportion of this interorbital breadth to the length, 1: 1.63. This proportion, in de Haan's figure, is 1:1.93. Our specimen differs from those described by de Haan in its more depressed form, its narrower and smoother carapax and broader front. There is no tooth within at the base of the movable finger, and none on the outer base of the hand. The horns of the rostrum are longer than in the adult *D. affinis*, and the abdomen of the male is not dilated near the base.

Having no opportunities of comparing our specimen with the young of the species to which it is here referred, we do not venture to consider it distinct.

It was taken in a harbor on the northwest coast of the Island of Ousima.

*Equivalent to *Schizophrys aspera* (Milne Edwards). See page 91.—M. J. R.

Mithrax suborbicularis Stimpson.*

Plate VIII, Fig. 2.

Proc. Acad. Nat. Sci. Phila., IX, p. 218, 1857.

This species belongs to the division *Mithrax transversaux* of Milne Edwards. The following description is taken from a sterile female, the only specimen found: Carapax rounded, not narrowed anteriorly; length and breadth equal; margins dentated with teeth of moderate size. Gastric region broad and convex. Upper surface with about thirty small, nearly equidistant, prominent warts, the interspaces granulated. Rostrum formed of two small, sharp, triangular, diverging horns, outside of which on either side project three slender spines belonging to the anterior margin of the basal joint of the antennæ. Eyes large. Superior margin of orbit with two deep fissures, and three teeth, the middle one of which is short, truncate, with a trifid clove-like apex. The tooth at the external angle of the orbit is rather long and sharp, curving forward; immediately behind this there are two teeth on the antero-lateral margin just in front of the hepatic constriction. Behind this constriction on the lateral margin of the carapax there are six teeth, the posterior ones very small, and placed rather above than on the margin. At the posterior extremity of the shell there are two small, blunt submarginal teeth. Outer pterygostomian regions with granulated surface upon which arise a few tubercles. Hectognathopoda and the adjoining triangular surface smooth and ungranulated. Fossæ of the inner antennæ excavated in the inferior side of the horns of the rostrum. Chelopoda small, slender, smooth, and glossy. Ambulatory feet hairy above; three of the joints spinulose; below smooth. Those of the posterior pair nearly smooth above.

The color in the preserved specimen is white, tinged with reddish brown. Dimensions: Length of carapax, 0.8; greatest breadth, the same; breadth between tips of the larger spines of the antennæ, 0.4; between tips of the spines at outer angle of orbit, 0.57 inch.

It was taken at Selio Island, Gaspar Straits, by Mr. L. M. Squires of the steamer *John Hancock*.

Eurynome longimana Stimpson.

Plate VIII, Fig. 1.

Proc. Acad. Nat. Sci. Phila., IX, p. 220, 1857.

Carapax with the regions distinct but not deeply separated; proportion of breadth to length, 1:1.38. Upper surface rugose, the rugosities consisting of rounded, flattened warts, somewhat irregular in size, and sometimes confluent. A large triangular tooth behind the orbit at the hepatic region; five teeth on the branchial region, four of which are

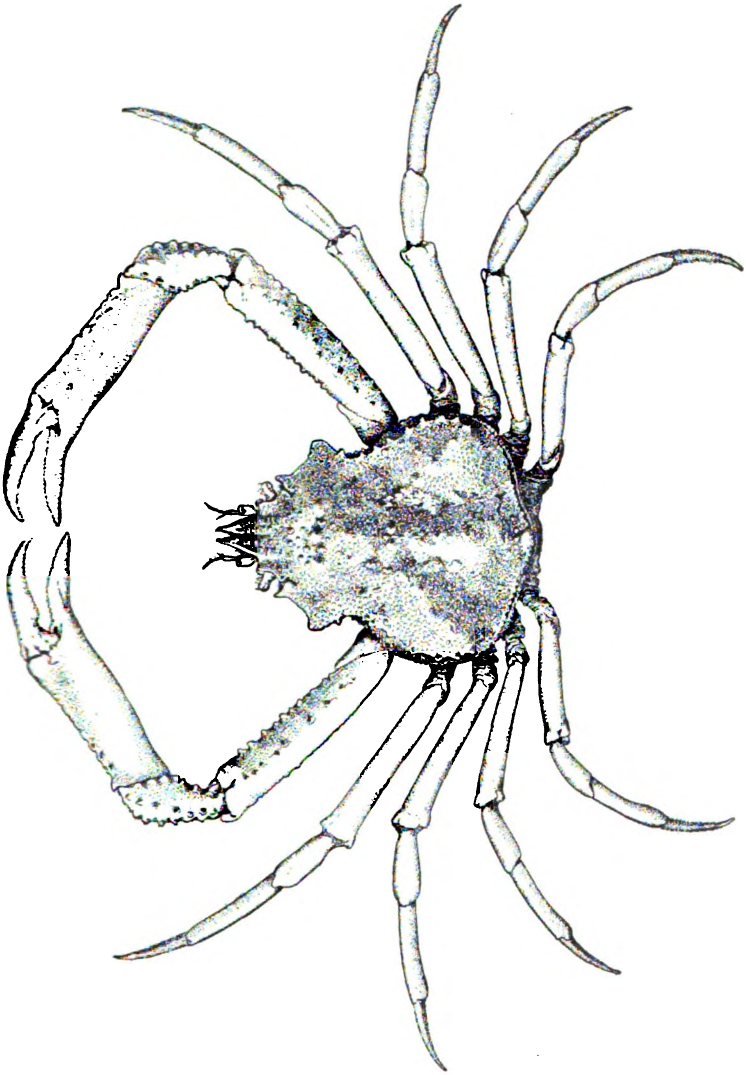
***Cyclomaia suborbicularis* Stimpson, Amer. Jour. Sci., XXIX, p. 133, 1860.
Cyclax (*Cyclomaia*) *suborbicularis* Miers, Jour. Linn. Soc. London, XIV, p. 660, 1879.—M. J. R.

marginal or submarginal, and one erect at the center of the region. Two small spines on the gastric region. Cardiac region rather prominent, oblong. Posterior margin with a slight protuberance on each side. Rostrum deeply bifid; horns long and sharp, somewhat divergent. Orbits and antennæ much as in *E. aspera*, except that the superior orbital fissure is not open. Hectognathopoda roughly granulated. Chelopoda of male nearly twice as long as the carapax, granulated and somewhat spinous; hand rather slender, with three or four stout spines toward extremity on superior inner margin. Pincers deflexed. Ambulatory feet bicarinate above, the carinæ most distinct on the merus, where they are each 3–4 toothed.

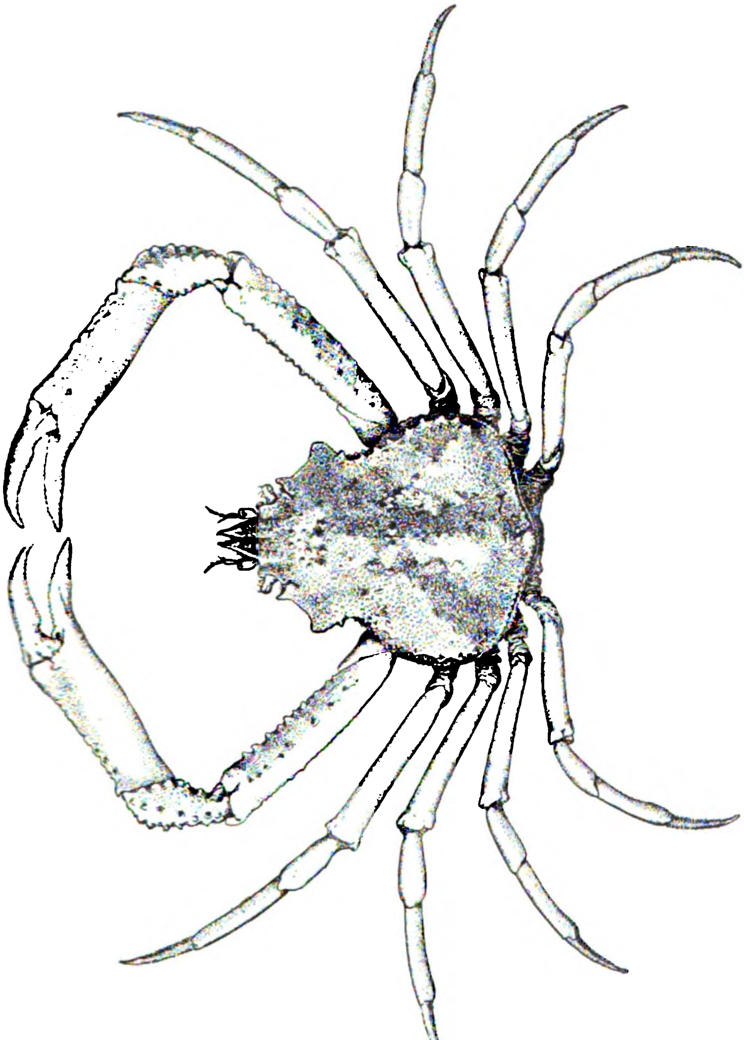
In the female the carapax is pubescent and more convex than in the male; the chelopoda are very short, and the hand scarcely twice as long as broad.

Colors: Carapax above dull red; feet whitish, or variegated with pale red. Eyes small, black. Dimensions of ♂, length of carapax, 0.47; breadth, 0.34; length of rostrum, 0.12; of chelopod, 0.8 inch; of ♀, length of carapax, 0.39; of chelopod, 0.3 inch.

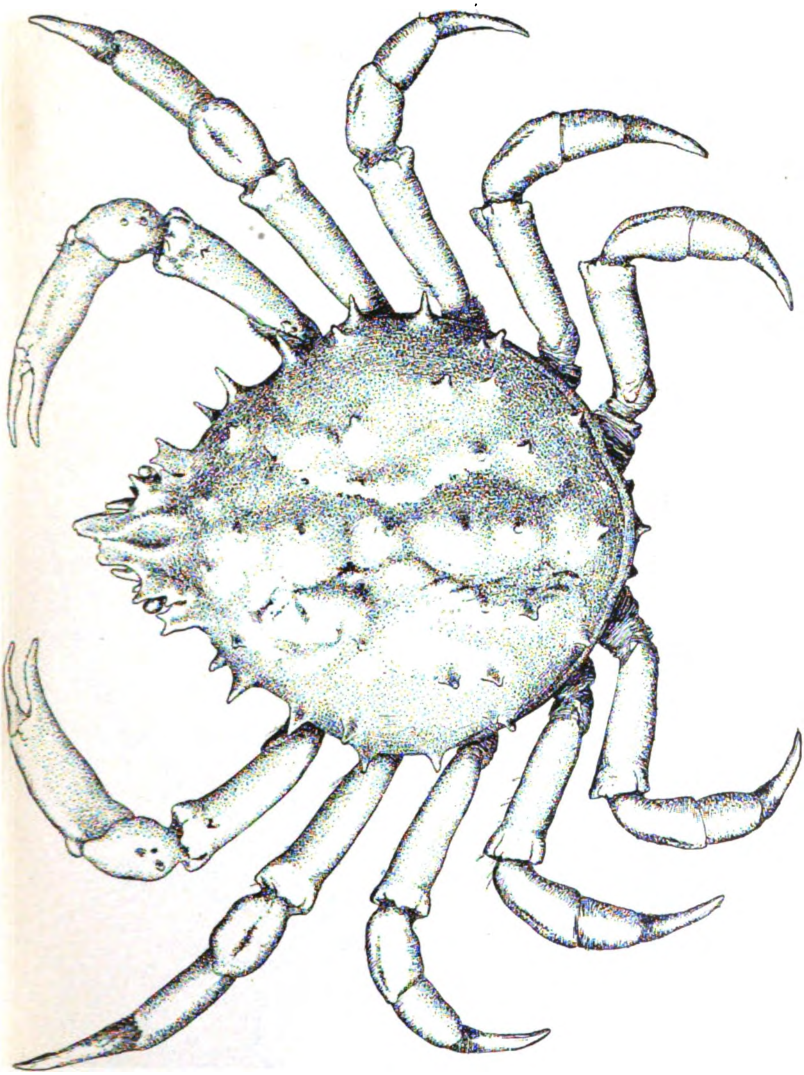
Dredged in 10 fathoms, on a rocky bottom, among Gorgoniæ, etc., in False Bay, Cape of Good Hope.



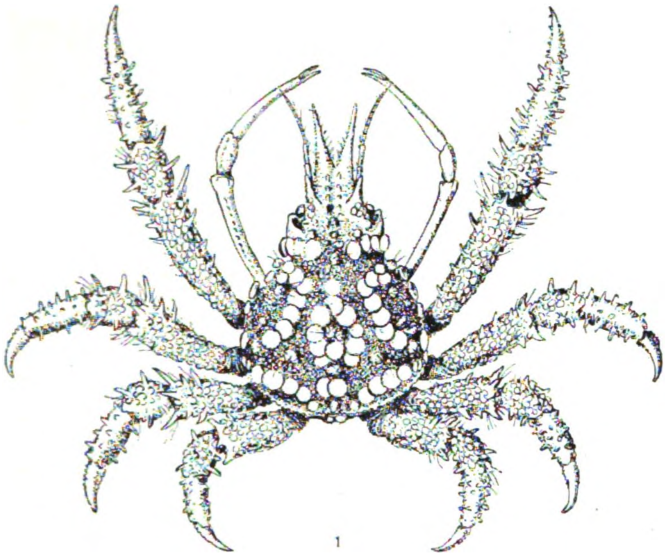
Hyas lyratus Dana, ♂, × ½.



Hyas lyratus Dana, ♂, × ½.



Cœlocerus grandis, sp. nov., ♀, × ½.



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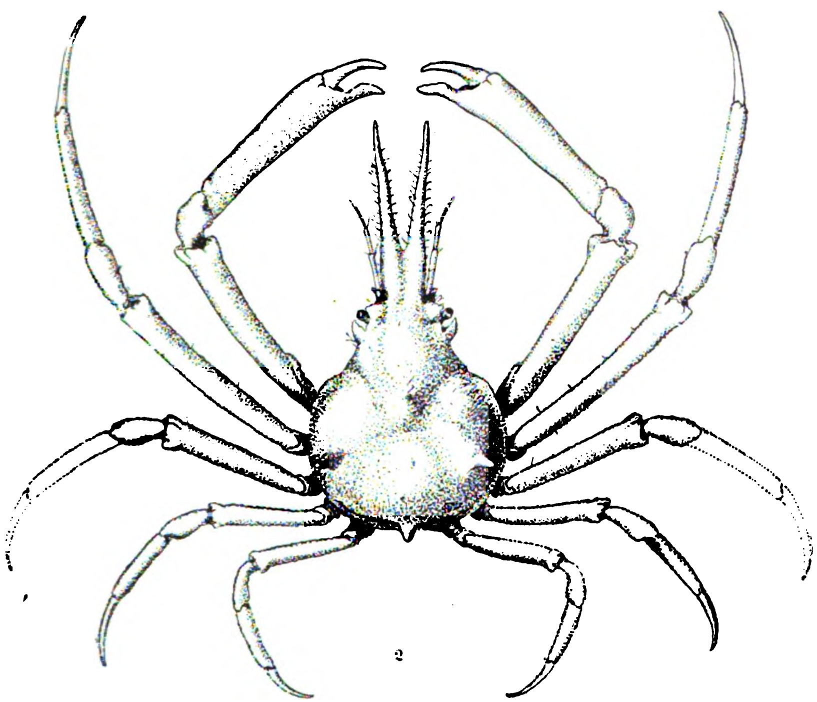

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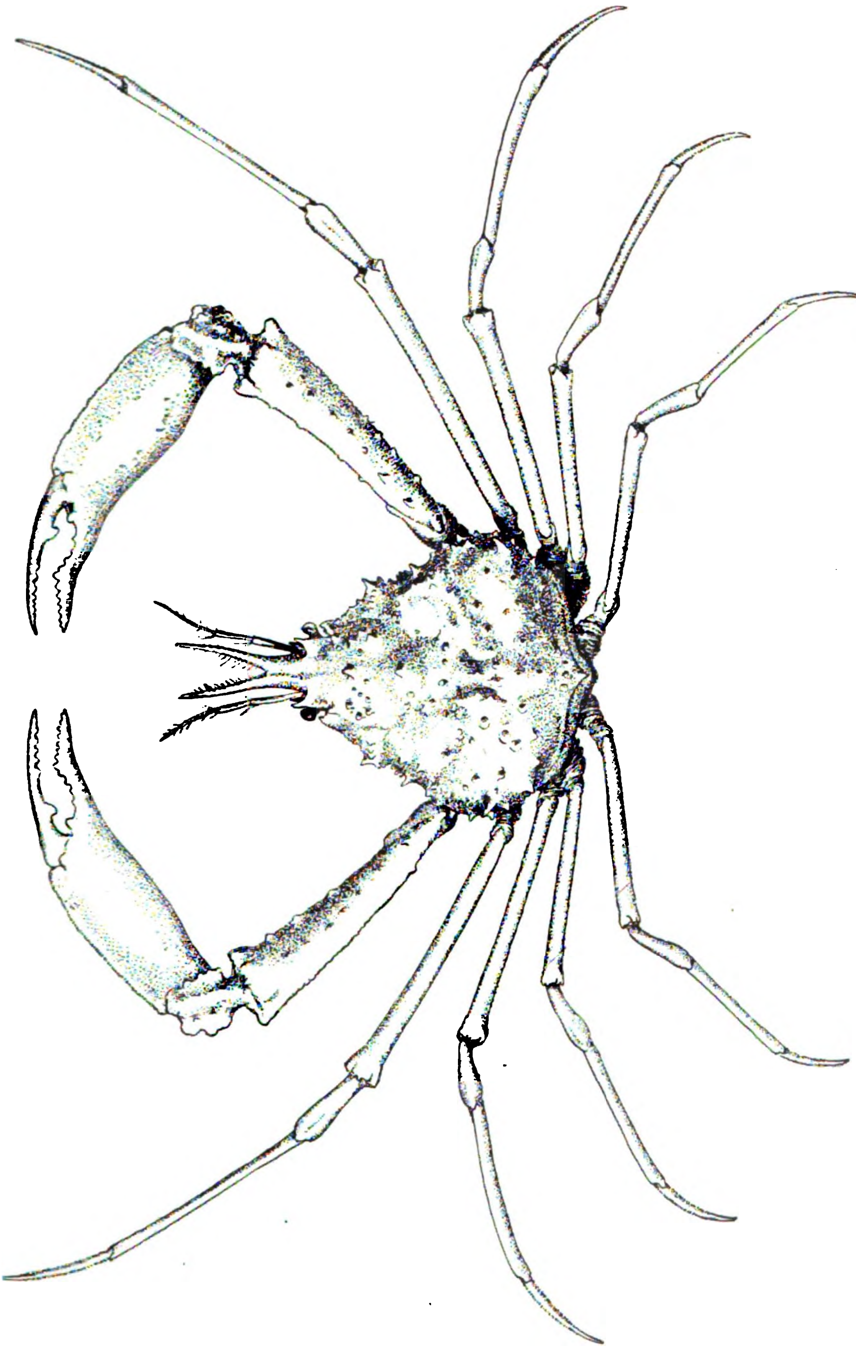
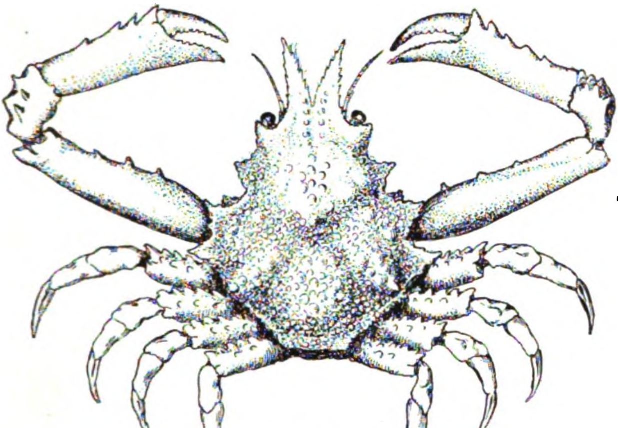
Fig. 1. *Lepteces ornatus*, gen. et sp. nov., ♂ × 2⅜.
Fig. 2. *Hyastenus caribbæus*, sp. nov., ♂, × 2⅜.



Hyastenus longipes (Dana), ♂, × ½.



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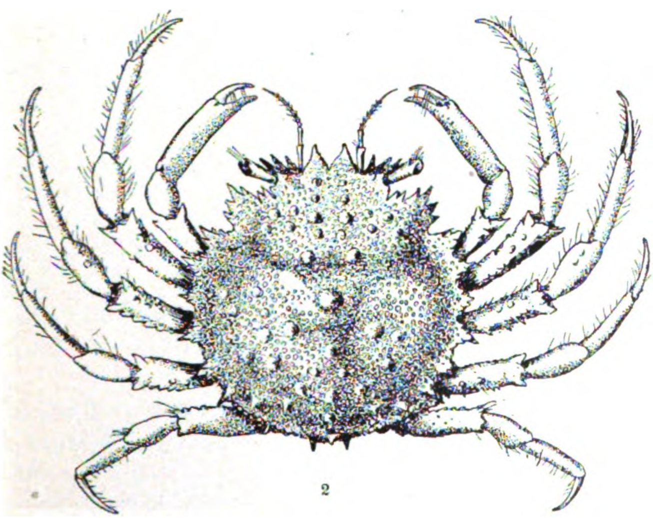

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Fig. 1. *Eurynome longimana* Stimpson, ♂, × $3\frac{1}{3}$.
Fig. 2. *Cyclax* (*Cyclomaia*) *suborbicularis* (Stimpson), ♀, × 2.

NOTES ON ERIAN (DEVONIAN) PLANTS FROM NEW YORK AND PENNSYLVANIA.

BY

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(With Plates IX–XIV.)

Among a large number of Erian plants submitted to Sir William Dawson and myself by Mr. C. S. Prosser, of the U. S. Geological Survey, were several which seemed to admit of ready identification. The larger part were, however, of a doubtful character, in small fragments, or appeared to be hitherto undescribed, and thus demanded special examination. The results obtained by me are embodied in the following notes:

The history of the specimens, as derived from Mr. Prosser, is as follows:

Nos. 3, 6, and 7 are from Skunnemunk Mountain, Orange County, N. Y. The rocks from which they were obtained are designated simply as Devonian.

No. 45 is from the same locality, but derived from the collection of Prof. D. S. Martin, of New York City.

Nos. 8, 9, 19, and 36 are from the Upper Chemung of Lanesboro, Susquehanna County, Pa., and are deposited in gray mica slate.

Nos. 15, 28, and 32 are from the Hamilton Group of West Hurley, Ulster County, N. Y.

Nos. 21, 24, 27, 37, 38, 39, and 41 are from the Genesee shale of Lake Canandaigua, N. Y.

Nos. 25 and 42 are from the Genesee Shale of Penn Yan, N. Y., while No. 20 is from the Marcellus Shales at Union Springs, Cayuga Lake, New York.

Owing to the very imperfect nature of much of this material I have deemed it expedient to separate all such from the more determinable, and have thus brought the whole under the two general heads of (1) dubious species and (2) determinable species.

DUBIOUS SPECIES.

A number of the specimens consist of small fragments and show either so little structure or so complete an absence of it as to render it inexpedient to assign any definite positions to them at the present time, more particularly as they can not be made to harmonize with any

previously described species, although in one or two cases there are certain general resemblances which may prove to have greater significance when more complete material is secured. It will, therefore, be sufficient to place their descriptions on record.

No. 24 is a fragment of a small, branching plant of very imperfect preservation and obscure characters.

No. 45 is a fragment of some large plant, which shows a number of coarse, parallel striæ, the fragment being too small to exhibit their terminations. I should be inclined to refer this to *Calamites transitionis* Göpp. or to some closely allied species.* Comparison should be made with *Calamites ramosus* Artis., and *C. pachyderma* Brongn.;† also with *Bornia radiata* Brong.‡ and *B. scrobiculata* Sternb.§

Nos. 6 and 7 are probably structures of the same nature. They represent aggregations of similar, simple, straight filaments about 1.5 to 2^{mm} in diameter, disposed in a parallel manner. They were originally structures of considerable volume, as their transverse section is nearly round. It is not unlikely that they represent roots, but it is impossible to assign them to any particular plant.

Nos. 27 and 37 are fragments of similar linear, branching stems, 11 and 12^{cm} long by 3 and 5^{mm} wide. They show no structure whatever and can not at present be referred to any species.

No. 38 is a fragment of a stem without branches, 8^{cm} long and 1.5^{cm} wide. It shows no structure beyond four longitudinal and parallel ridges or nerves, which are about equidistant. It is probable that this may be a fragment of the same species as No. 25.

No. 41 is a narrow stem 12^{cm} long and 3^{mm} wide, showing no lateral members for a distance of 7^{cm} beyond which there appear, on opposite sides, what are either the stumps of branches, or more probably, perhaps, the basal portions of leaves. They are distant 3^{cm}. The specimen bears a slight resemblance to *Parka decipiens*, but the relation can not be satisfactorily established.

Nos. 23 and 40 are of the same nature. Each is a small fragment of a stem showing near one end a pair of branches or leaves, of which only the basal portions remain. The stem is 4^{mm} wide. The specimens are altogether too fragmentary to admit of their reference to any species, but in this connection reference should be made to *Calamites radiatus*‖ Brongn. (*Archæocalamites*, Sternb.), as it is quite possible these fragments may be parts of this plant.

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* Göppert: Foss. Flora des Übergangsgebirges, p. 116, Pl. III, IV. Dawson: Foss. Plants of the Dev. and U. Sil. of Canada, Geolog. Survey of Canada, 1871, p. 25, Pl. IV.

† Brongniart: Hist. des Vég. Foss., I, 127, Pl. XVII, XXII.

‡ Schimper: Traité de Pal. Vég., Pl. XXIV.

§ Göppert: Foss. Flora des Übergangsgebirges, Pl. X.

‖ Dawson: Geol. Hist. of Plants, p. 170; Solms Laubach: Foss. Bot. Eng., ed. Trans. p. 320, Fig. 44; Brongniart: Hist. des Vég. Foss., I, p. 122, Pl. XXVI; Dawson: Foss. Plants of the Dev. and U. Sil. of Canada; Geolog. Survey of Canada, 1871, p. 25, Pl. IV, Fig. 42.

Nos. 21 and 39 are two short fragments 7^{mm} wide and 7.5^{cm} long. Each shows near its base a short stump of a lateral member, and alternately with this at the top, a lateral member which is 3.5^{cm} long and 4^{mm} wide. The surface shows no structural markings beyond three longitudinal striæ. It is very probable that these are fragments of a fern stipe of species similar to No. 25, although it is also to be observed that they bear a certain resemblance to highly altered specimens of Psilophyton nerve recently brought under my notice.

No. 25 is an imperfect specimen, of which one side is wholly wanting. It is 1.8^{cm} wide and 22^{cm} long. On one side it shows the basal portions of five pinnæ with enlarged articulations. They are distant 3.5^{cm} and 6^{cm}. The surface shows two coarse longitudinal ridges and numerous fine striæ. This is an undoubted *Cyclopteris*,* and closely resembles a specimen in the Peter Redpath Museum of McGill College, marked *C. Acadica.*

No. 26 consists of narrow, leaf-like filaments 2^{mm} wide at the base, but broadening upward to 4^{mm}. At a total length of 9^{cm} they are incomplete. They show no structure beyond two nerves. They are strongly suggestive of the leaflets of a Cycadaceous plant. They are also equally suggestive of the leaves of *Schizoneura paradoxa* Sch.† or of *S. Meriani* Sch.‡ with which comparison should be made. [Pl. IX, Fig. 3.]

No. 3 consists of linear filaments 2 to 4^{mm} wide, with a somewhat conspicuous midrib or axis. A small fragment on the opposite side of the stone shows a branching similar to that of *Haliserites*, but as it is not repeated it might also be that of a root. It is a very problematical specimen, which requires further material for determination. It is not unlikely that it represents a poorly preserved specimen of *Haliserites Dechenianus.* [Pl. IX, Fig. 4.]

No. 42 consists of a tuft of narrowly linear, simple filaments, apparently leaves, about 0.75^{mm} in diameter and upwards of 14^{cm} long. No structure is apparent, and the specimen is altogether too incomplete to admit of reference to a particular species. [Pl. X, Fig. 5.]

DETERMINABLE SPECIES.§

Specimens numbered 8, 9, 16, 17, 18, 19, 20, and 36 present many features in common. They all agree in their regular dichotomous divisions and linear ramuli. None of them show signs of fructification, while some are distinctly costate and others are not.

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* Rept. on Foss. Plants of the Dev. and U. Sil. of Canada, Geol. Surv. of Can. 1871, 215; pl. XV.

† Schimper: Traité de Pal. Foss., Pl. XIII, Fig. 8.

‡ *Ibid.*, Pl. XV, Fig. 1.

§ In connection with my determination of these species, I desire to acknowledge the courtesy with which Dr. W. G. Farlow of Harvard University, placed at my disposal his valuable collection of Marine Algae; also to Dr. G. L. Goodale for permitting reference to the large collection of fossil plants in the Museum of Comparative Zoölogy.

Upon an informal examination I was inclined to regard them as altogether distinct from *Haliserites Dechenianus* Göpp, to which certain of them had been referred; but, after carefully describing each separately and comparing them with one another, it became evident that a generic relationship existed between them, while repeated examinations only tended to strengthen the view that some at least could be identified with *Haliserites*, while others must be nearly related. In order to ascertain their proper relationships it will be desirable to examine the characters of the genus *Haliserites* as employed by Sternberg and Göppert and compare this genus with the modern genera *Haliseris* and *Dictyota* in order to ascertain upon which it was based.

Sternberg* applied the following characters to the genus *Haliserites*:

Frons plana, membranacea, costata, sporangia capsularia in lamina frondis ad costam coacervata.

Göppert,† in assigning the species *Dechenianus* to this genus, describes it in the following terms:

Fronde plana attenuatim dichotome ramosa, ramis ramulisque linearibus costatis æqualibus apice quandoque circinatis, costis mediis.

From this description, as also from his figures, it seems probable that he confounded *Psilophyton* with *Haliserites*. In fact some of his plants referred to the latter have been shown to belong to the former. With respect to what belong properly to *Haliserites*, he elsewhere‡ speaks of both broad and narrow forms. It is therefore most probable that this genus was based upon the modern species *Haliseris dichotoma* Sprengel,§ as it shows also both narrow and broad forms, and the agreement with *Haliserites* is very close throughout, but the *Haliseris dichotoma* of Sprengel is now *Dictyota dichotoma* of Lamoureux, a fact which it is important to keep in view, while we should also not lose sight of the fact that certain species of Dictyota, e. g. *D. divaricata* Agh., show recurved terminations, which, with the dichotomous division, give the plant the appearance of many specimens of Psilophyton. *Haliseris* and *Dictyota* differ in their external characters, apart from the fruit, in the fact that in the former there is a distinct midrib and the terminations of the ultimate ramifications are simple, while in the latter the ramuli are not costate and their terminations are generally bifid. Both agree in having a regularly dichotomous frond with more or less linear divisions.‖ This, together with the transfer to *Psilophyton* of a number of plants originally referred by Göppert to *Haliserites*, seems to render it desirable to give a fresh definition of the characters which distinguish this latter genus.

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*Sternberg: Vers., II, p. 34.

†Göppert: Foss. Flora des Übergangsgebirges, p. 88, Pl. II. See also pp. 40 and 259.

‡*Ibid.*, p. 89.

§Sowerby: English Bot., XII, p. 44, Pl. 2336.

‖Sowerby: English Bot., XII, pp. 438, 49, 109. Harvey: Nereis Boreali Americana, I, pp. 102, 108, Pl. VII, A.

In the light of these data, it becomes possible to separate our fossils into two groups. Nos. 8, 9, 16, 17, and 36 are costate throughout and show single terminations of the ramuli. Their affinities are thus clearly with *Haliseris* and they must, therefore, be referred to the genus *Haliserites*. Nos. 18, 19, and 20 are not costate and the terminations of the ramuli are distinctly bifid. Their affinities are with *Dictyota* and they consequently should be referred to a related genus.

Brongniart* formerly referred a large number of fossils of diverse character to the genus *Fucoides*, some of which he brought under the division *Dictyotites* from the general resemblance they bore to *Dictyota*. These have since been variously distributed among different genera, so that the name *Dictyotites* has lost its function, and so far as I am aware it is now altogether obsolete. It therefore seems admissible to reintroduce the name as a generic one, under which specimens 18, 19, and 20 may be described.

Haliserites Dechenianus Göpp. Pl. x, Fig. 6.

This species is represented in No. 17 by an imperfect plant answering to the following:

Frond dichotomous; divisions linear 3.5^{mm} wide; angle of divergence 40°; midrib prominent throughout, margin wavy.

The specimen shows no normal terminations of any of the ultimate divisions, but its general characteristics are otherwise so well defined that it is quite safe to refer it to the above species. Mr. Prosser informs me that this fossil was identified by Lesquereux as a *fruiting* frond of *H. Dechenianus*. This I consider inadmissible. The parts mistaken by Lesquereux for fruit are, as the specimen clearly shows, nothing else than alternate elevations and depressions in the marginal portions of the ramuli caused by a wavy margin such as is not uncommon among membranaceous algæ.

Haliserites Dechenianus Göpp., var. **lineatus** Pn., nov. var. Pl. x, Fig. 7.

In No. 8 the frond is regularly dichotomous throughout; divisions linear, sometimes somewhat narrower at the base, chiefly 2.25^{mm} broad. The divergence of members is from 30° to 44°, chiefly about 40°. Midrib well defined throughout, but small. Margins regular.

This appears to correspond to the narrow form of Göppert's *H. Dechenianus* and, according to Mr. Prosser, it was so identified by Lesquereux. It would seem better, however, in view of the conspicuous differences between it and the preceding, to distinguish it by a varietal name, for which I would suggest the one given above.

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* Histoire des Vég. Fossiles, p. 67, Pl. v, VII, and IX.

Haliserites lineatus, sp. nov. Pl. x, Fig. 8*a;* Pl. xi, Fig. 8*b*.

This is represented by the two specimens, Nos. 16 and 36, which are undoubtedly only forms of the same species. In No. 16, the frond is dichotomous, divisions linear. Larger ramuli 2.25 to 4^{mm} broad, the terminal ramuli 0.5 to 1.5^{mm} broad. Divergence of members 30° to 50°. Costate throughout, margins strict.

In No. 36 the frond is dichotomus, divisions linear. Principal ramuli 3^{mm} wide, ultimate divisions 1^{mm} or less. Divergence of the larger members about 14°, of the smaller divisions 26° to 30° and 40°. Costate throughout, margins regular.

No. 16 was identified by Lesquereux as a narrow form of *H. Dechenianus*, but I think the difference too great.

Haliserites chondriformis, sp. nov. Pl. xi, Fig. 9.

No. 9 is a specimen which presents, at first sight, very peculiar features. It is somewhat remarkable for the wide divergence of its principal members, for an apparent stipe and the peculiar form of one of its chief divisions. On close examination, it is seen that the otherwise regular division of the frond is disturbed by an abnormal growth in one of its principal segments. The apparent stipe resolves itself into the midrib, from which the marginal parts have been more or less completely separated by decay, as is obvious from detached fragments which lie along each side. The midrib itself is prominent as a depressed line, showing the collapse of what was originally a somewhat bulky structure, but it seems to disappear shortly after passing into the more expanding portions of the frond. A detailed examination shows a dichotomous frond, divisions linear, sometimes broadening upward. Principal angles 90°; those of the ultimate divisions 40° to 55°, chiefly 55°. Ramuli 2 to 3^{mm} wide. Midrib obvious, becoming very prominent in the basal portions. Margin regular.

The general features of this fossil are closely represented among modern algæ by *Haliseris delicatula* Lamour., but much more closely by *H. Muelleri*, which shows the same narrow, stipe-like base with the Chondriformis divisions of the principal part of the frond.

Dictyotites fasciolus, sp. nov. Pl. xi, Fig. 10*a;* Pl. xii, Fig. 10*b*.

In No. 19 the fronds are dichotomous, divisions numerous and narrowly linear, 1.5^{mm} wide, forming a more or less tufted mass. Primary divisions for the most part obscure, but obviously bifid, the lobes short and rounded.

In this fossil the narrow ramuli are so massed as to obscure the normal division, but from the terminations of the ramuli it is probably safe to refer it to *Dictyotites*, although the state of preservation does not admit of determining the presence of a midrib. Its whole aspect is so

strongly suggestive of *Dictyota fasciola* Lamour.* that I have deemed it advisable to assign it the above name.

In No. 18 we also have a plant which is in all probability the same species.

Fronds dichotomous, ramuli narrowly linear, 1 to 1.5^{mm} wide and not costate, aggregated in tufts. This is a very imperfect specimen, but I think there can be little doubt as to its identity with the preceding.

Dictyotites maximus, sp. nov. Pl. XI, Fig. 11.

No. 20 is a fragment of a plant so imperfectly representing important details of structure as to render its proper relationship extremely problematical.

Fronds regularly dichotomous, divisions linear, 2.75 to 3.5^{mm} wide. Divergences of members 55° to 60°. Midrib none, margins regular.

In this specimen there are no normal terminations of the ramuli, and the state of the preservation is such as to render it impossible to dedetermine if the plant was originally costate. At each bifurcation, a third member is seen, but from their relative positions I am led to consider them parts of another plant accidentally associated. The plant is certainly either *Haliserites* or *Dictyotites*, but which is doubtful. I will, therefore, refer it provisionally to *Dictyotites maximus* as indicative of its obviously large size.

Psilophyton grandis, sp. nov. Pl. XII, Fig. 12*a*; Pl. XIII, Fig. 12*b*; Pl. XIV, Fig. 12*c*.

The material comprised in Nos. 15, 28, and 32 is all of the same character and obviously fragments of plants of the same species. No. 15 shows on one side numerous fragments of narrow stems of the same size and character as in No. 32. On each side of the main axis there is a row of compactly arranged acute scales 1^{mm} broad at the base in a vertical direction and 2^{mm} long. There is also a circinate termination of a branch, which measures 1^{cm} in diameter. The opposite side of the same slab shows two fragments of stems. These are 18^{cm} long and 1.5^{cm} wide, each. They show a somewhat carbonized mass, but no well-defined surface markings. The margins show well developed scales. These are 2^{mm} broad at the base—measured vertically—and are distant, from center to center, 5^{mm}. They are all more or less broken off, but a prolongation of their sides shows them to have been lanceolate, acute, slightly curved upward, and 5^{mm} long.

In No. 28 there are on one side of the slab fragments of branching stems 6^{mm} to 8^{mm} wide, with lateral rows of closely arranged scales of the same dimensions as in 32 and 15. None of these stems show well-defined surface markings.

On the opposite side of the slab are dichotomously branching stems of all sizes, evidently parts of the same or of similar plants. Nearly all

*Harvey: Nereis Boreali Americana, I, 108, Pl. VIII, B.

these stems show more or less well-defined and perfect lateral rows of scales which are triangular, acute, 1^{mm} broad at the base and 2^{mm} long. In the larger stems the scales become somewhat larger. There are few surface markings, but where they occur they are the same as in No. 32. No. 32 is chiefly represented by a branching stem 5^{mm} wide and 21^{cm} long. The branch separates from the main stem by a somewhat narrow angle, a feature which characterizes nearly all the fragments on these three slabs. Lateral rows of scales are prominent. These are triangular, acute, 1^{mm} long by 0.5^{mm} broad at the base, and are closely arranged. This stem does not show any well-defined surface markings.

There are also numerous short fragments of stems. One of these is 1^{mm} broad and branching, and is an undoubted *Psilophyton*. Other pieces show somewhat obscure superficial markings in the form of pits similar to those in *Psilophyton robustius* and *P. princeps*. Others again show distinct transverse markings, which are triangular, acute, 1^{mm} broad at the base and 2^{mm} long. They are undoubtedly to be regarded as the scales of the stems turned over and flattened down upon it transversely to its axis. From their relative positions, it is probable that the scales are disposed spirally.

From these details it would seem clear that the plant in question must be a *Psilophyton*, but differing materially from those already described,* chiefly in point of size and in the size and aggregation of the scales. I would, therefore, propose for it the name of *Psilophyton grandis*, as it was obviously a plant of much larger dimensions than any of the hitherto known species.

Upon the data thus presented, the following classification becomes admissible.

Genus **HALISERITES** Sternb.

Fronds plane, membranaceous, costate and dichotomous throughout; the more or less linear ramuli with simple terminations. Sporangia in groups lateral to the midrib.

Haliserites Dechenianus Göpp.

Fronds regularly dichotomous; the divisions linear, 3^{mm} or more wide; margins regular or wavy, terminations strict. Angles of divergence about 40°. Equally and strongly costate throughout.

Haliserites Dechenianus Göpp., var. **lineatus**, nov. var.

Fronds regularly dichotomous throughout; divisions linear, often somewhat narrower at the base, 2.25^{mm} broad. Divergence of members 40°, margins regular, midrib well defined throughout, but not prominent.

*Dawson: Foss. Plants of the Dev. and U. Sil of Canada, Geological Surv. of Canada, 1871, pp. 37–41, Pl. IX, X.

Haliserites lineatus, sp. nov.

Fronds dichotomous throughout; divisions linear, the larger members upwards of 4^{mm} broad, the terminal ramuli 1^{mm} or less, and strict. Divergence of members from 14° to 50°. Costate throughout, costa not prominent; margin regular.

Haliserites chondriformis, sp. nov.

Fronds dichotomous; divisions linear, the larger members sometimes exhibiting an unusual form. Ultimate ramuli 2 to 3^{mm} broad, strict. Principal angles of divergence 90°, those of the smaller members, 40° to 55°. Midrib obvious, becoming very prominent below; the base of the frond contracted into a narrow stipe; margins regular.

The general aspect is that of *Chondrus*.

Genus **DICTYOTITES**, gen. nov.

Fronds plane, membranaceous, and regularly dichotomous, the ultimate ramuli generally bifid. Midrib none, margins regular

Dictyotites fasciolus, sp. nov.

Fronds dichotomous, divisions narrowly linear, 1 to 1.5^{mm} wide, and generally aggregated in tufts.

Dictyotites maximus, sp. nov.?

Frond regularly dichotomous, the divisions linear, about 3^{mm} broad. Divergences of members about 60°. Margins regular.

Genus **PSILOPHYTON** Dn.

Psilophyton grandis, sp. nov.

Stem 1.5^{cm} in diameter, branching dichotomously into slender ramifications; angles of divergence narrow; terminations of branchlets circinate. Leaves in the form of spirally arranged, lanceolate, and acute scales curved slightly upward, those of the main stem 2^{mm} broad at the base and 5^{mm} long, distant 5^{mm}; those of the branches becoming smaller and more closely aggregated, finally 1^{mm} broad and 2^{mm} long. Surface markings as poorly defined pits or short longitudinal striæ. Fruit none. Plants chiefly found as impressions, rarely carbonized.

EXPLANATION OF FIGURES. Plates IX–XIV.

No. 1. Fragment of a fern? Similar to No. 25. Natural size.
No. 2. Fragment of a fern? Rhachis × $\frac{3}{2}$.
No. 3. Leaves of *Schizoneura*? or some allied plant. Natural size.
No. 4. Roots or possibly *Haliserites*. Natural size.
No. 5. Grass-like leaves of undeterminable character. Natural size.
No. 6. Frond of *Haliserites Dechenianus* Göpp., showing a wavy margin. Natural size.

No. 7. Frond of *Haliserites Dechenianus* Göpp., var. *lineatus*, Pen. Natural size.
No. 8*a*. Frond of *Haliserites lineatus* Pen. × ⅜.
8*b*. A frond of the same species. Natural size.
No. 9. *Haliserites chondriformis* Pen. Natural size.
No. 10*a*, *b*. Fronds of *Dictyotites fasciolus* Pen. Natural size.
No. 11. Partial frond of *Dictyotites maximus?* Pen. Natural size.
No. 12. Various portions of *Psilophyton grandis* Pen., showing circinate termination, ramification, leaves, etc.
(*a*) Showing various portions of branching stems which also exhibit the scales. Natural size.
(*b*) Portions of the large stems showing the scales. × 1⅜.
(*c*) A branching stem showing fine scales. Natural size.

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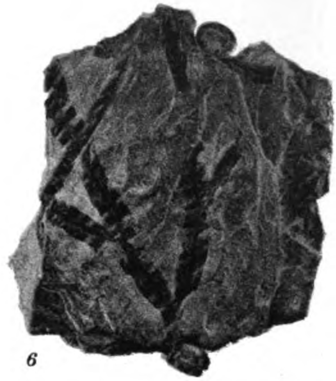

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10 b

12 a

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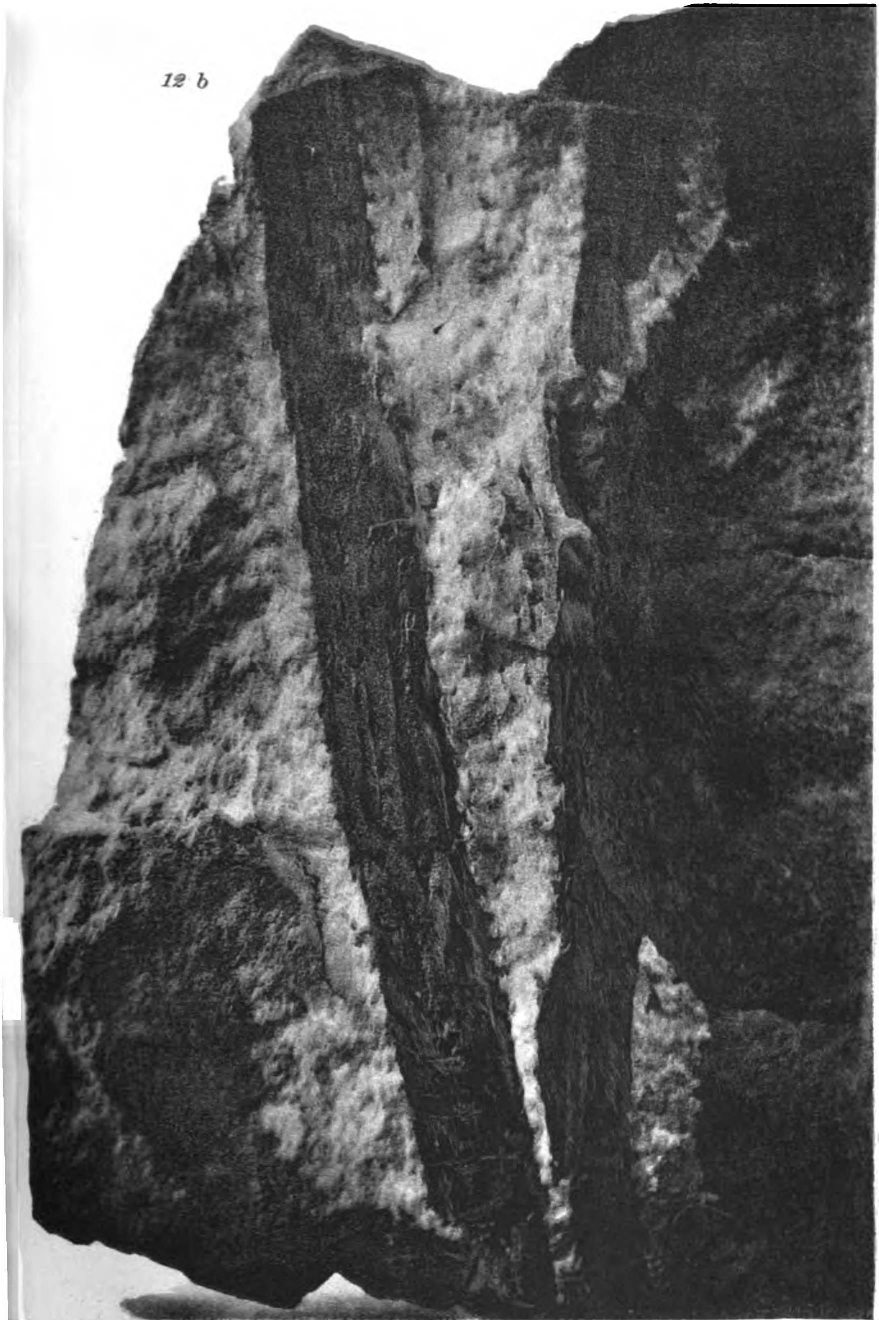

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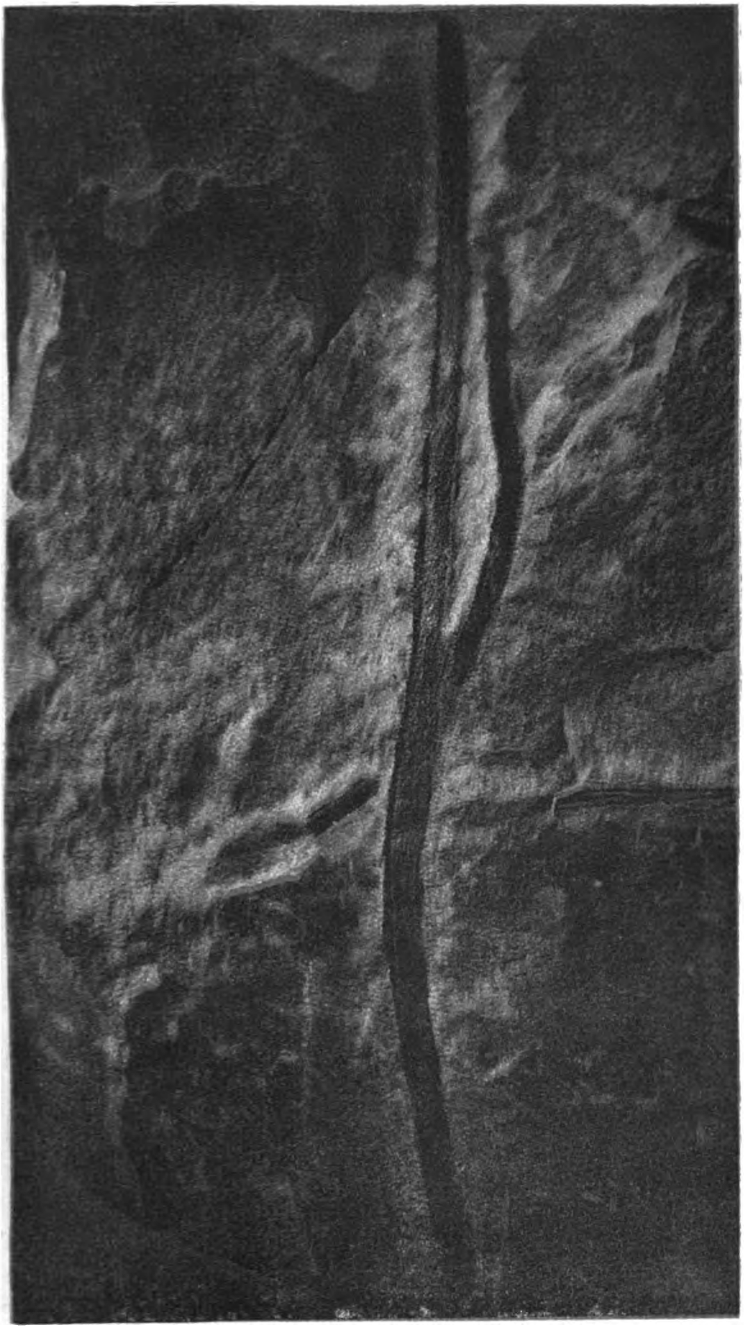

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NOTES ON NEMATOPHYTON CRASSUM.

BY

D. P. PENHALLOW, B. Sc., F. R. S. C.,

McGill University, Montreal.

(With Plates XV–XVIII.)

In a former paper* I had the occasion to describe certain fossils from the middle Erian of New York, and referred them to *Nematophyton crassum*, Pen., although originally described by Sir William Dawson under the name of *Celluloxylon primævum*. This transfer was based upon indirect evidence and was regarded by me as requiring confirmation. It was, therefore, a matter of special congratulation when, during the past winter, fresh material was placed in my hands, which seemed to substantiate the correctness of my original determination.

In January last (1892) Prof. F. H. Knowlton, of the U. S. National Museum, informed me that new specimens of *N. crassum* (*Celluloxylon*) had been found in New York, and later transmitted three slides of sections, together with the stem from which they were taken, and also a slide of the type specimen of *Celluloxylon*. This latter was, therefore, from the same specimens as those originally described by me and upon which Sir William Dawson based the genus of that name. Additional comments upon this are not called for at this time, but reference should be made to my former description of its structure.

The other specimens forwarded by Prof. Knowlton were collected by Mr. C. S. Prosser, of the U. S. Geological Survey, from the Cooley Quarry on the southern extremity of Skunnemunk Mountain, Orange County, New York. According to information received from Mr. Prosser the horizon is to be regarded as in all probability middle Erian. It agrees, therefore, in its position, with that of *Celluloxylon*, which was obtained from the Hamilton Group in Hopewell, near Canandaigua.

The section of stem measures about 3 inches in diameter and shows no external evidence of structure beyond a band of prominent, longitudinal striæ on one side, and detached masses of carbonaceous matter on the opposite side. From this specimen three slices were cut in such a manner as to represent as nearly as possible the three usual directions of section. I shall, therefore, distinguish them by the usual terms.

* Trans Royal Soc., Can., VII. iv, 23.

TRANSVERSE SECTION.* $\frac{114\,c}{558}$

The transverse section as a whole shows considerable diversity of structure, obviously due to alteration in the process of decay and the subsequent formation of siliceous crystals. In one part the cell walls and all cell cavities are sharply defined. The cells are fairly uniform in size, ranging from 23 μ to 46 μ, with an average of 34 μ. The walls are very black and 3.8 μ thick. The cells are, as a rule, rather remote, being distant 3.8 μ to 49.4 μ, thus giving to the structure, as a whole, a very loose, open character. There is very rarely an indication of intercellular filaments where now and then a large one, running transversely, has survived the otherwise general disintegration of the hyphæ. All the intercellular spaces are occupied by a fine cellular appearance, due to the disposition of a very thin layer of the altered carbonaceous substance upon the surfaces of small crystals of silica.

In the other parts (see Fig. 7), $\frac{114c}{558}$, the large round cells are obvious, but the walls have become thickened in an irregular manner and have lost their sharp outlines in a marked degree, while they are commonly connected with one another by coarse lines of carbonaceous substance in such a way as to make the intercellular spaces appear like large and imperfectly formed parenchyma cells with irregularly thickened walls. All the intercellular spaces are occupied by a mass of fine crystals, having the appearance of a very fine cellular tissue.

In yet a third area (see Fig. 5), $\frac{114\,d}{558}$, the round cells of the first have almost absolutely disappeared. Only here and there can a trace of one be found. They have been wholly replaced by typical *Celluloxylon* structure, indistinguishable from that found in the original type specimens of that genus. That these three conditions do not represent normal structures is at once obvious from the transitional conditions to be found within the same section.

RADIAL ? SECTION ($\frac{115}{557}$).

In this the *Celluloxylon* structure is very prominent. In many places it shows derivation from tubular cells, the position of these latter being very obvious under a low power. As in the transverse section, there is no evidence of intercellular filaments. Rarely, obscure indications of open areas are met with.

TANGENTIAL ? SECTION ($\frac{116}{559}$).

The general structure is the same as in the radial section except that we here meet with well-defined evidence of open areas. These are irregular in form, somewhat numerous, and filled with a mass of very fine crystals of silica, about which carbonaceous matter has been deposited,

*The numbers given refer (numerator) to my laboratory number and (denominator) to the number as given in the collection of the U. S. Geological Survey.

so that the whole presents the aspect of a very fine cellular tissue similar to that which is found occupying the intercellular spaces of transverse sections. Into these open areas the large tubular cells are found to project in a vermicular manner, precisely as in perfectly preserved specimens of *Nematophyton Logani* and other species examined by me. The tubular cells are in no case perfect, but sufficiently so to indicate their original character. No evidence of intercellular filaments could be found.

Comparing these specimens with the type of *Nematophyton crassum*,* we find they agree with it in all respects except the absence of intercellular filaments from the former and their presence in the latter. But this difference may safely be attributed to the operation of greater alteration in one case than in the other, and it is therefore admissible to consider that my reference of *Celluloxylon primævum* to *Nematophyton crassum* was not only correct, but that it receives striking confirmation from these specimens.

It may also be well to place on record a few observations made during my examination of this material, as bearing upon the alteration of organic structure by decay and crystallization.

The extent of alteration appears to depend in the first instance upon the extent of decay in the organic structure at the time when crystallization of the infiltrated silica becomes pronounced, and thus upon the conditions favorable or adverse to freedom of growth in the crystals. This is clearly shown by the transitional forms of the structure as already described, which, in turn, also show that the imperfect tubular structure seen in longitudinal section and the large parenchyma-like cells of the typical *Celluloxylon* are derived, not from the tubular cells of the original structure, but from the spaces surrounding and lying between them; that is to say, crystals or groups of crystals form in the intercellular spaces and, finally, in the cell cavities in such a way as to crush the tubular cells into shapeless masses of carbon, which afterwards become more or less broken up or remain as large and irregular masses of carbon at the angles of the *Celluloxylon* cells.

Three stages in the conversion of the normal structure may be noted:

(*a*) Conversion of the intercellular hyphæ, the medullary structure remaining largely intact. This results in the formation throughout the intercellular spaces and in the open tracts of a fine *Celluloxylon* structure, due to the aggregation of numerous small crystals of silica, upon the surfaces of which the carbonaceous products of decay are deposited. This gives to the present specimen the peculiarities of structure which distinguish it from the typical *N. crassum*.

(*b*) Conversion of the intercellular hyphæ and partial conversion of the medullary structure the tubular character of which is nevertheless evident. There is also in this condition a partial formation of the

*Trans. Royal Soc. Can., VII, iv, 25, Pl. I, Fig. 5.

typical *Celluloxylon* structure, as determined by the development in the intercellular spaces of very large crystals or small crystals which arrange themselves in groups of corresponding size.

(*c*) Complete conversion of all the organic structure, which is now replaced by the typical *Celluloxylon* structure. Here the filaments of the medulla are broken up both transversely and longitudinally in such a way that the resulting *Celluloxylon* cells form long series occupying the intercellular spaces and having the aspect of vermicular filaments similar in position to those of the medulla, but having a considerably greater diameter. Between these three principal conditions all degrees of transition are to be noted.

EXPLANATION OF PLATES.

PLATE XV.

Fig. 1. Section from type specimen of *Celluloxylon primævum*, showing characteristic structure. × 154.

Fig. 2. Section of *Nematophyton Logani*, showing typical *Celluloxylon* structure. The same preparation exhibited typical *Nematophyton* structure. × 154.

PLATE XVI.

Fig. 3. Section of *Nematophyton crassum*, showing large cells of medulla, intercellular filaments, and an open area. × 154.

Fig. 4. Longitudinal section of the type specimen of *Celluloxylon primævum* from Prof. Knowlton, showing the disposition of the crystals to conform to the position of the tubular cells of the original structure. × 50.

PLATE XVII.

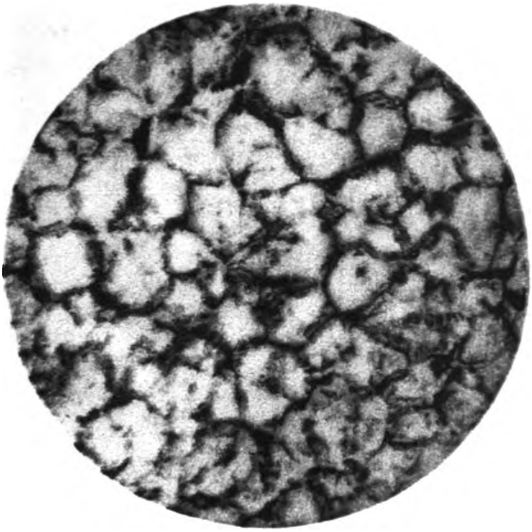
Fig. 5. Transverse section of *Celluloxylon* $\frac{114a}{558}$, showing characteristic structure, but the carbonaceous matter very much massed. Also showing remnants of occasional cells of the original structure. × 100.

Fig. 6. Transverse section from the same slide as the preceding, showing normal structure of the large tubular cells, but replacement of the intercellular filaments by fine crystals. Also showing an open area. $\frac{114a}{558}$ × 100.

PLATE XVIII.

Fig. 7. Transverse section from the same slide as the two preceding, showing conversion of the normal structure into *Celluloxylon* structure. $\frac{114c}{558}$ × 100.

Fig. 8. Longitudinal section, showing the tendency of the crystals to form along lines conformably to the original structure, and thus essentially the same as in Fig. 4. $\frac{115a}{557}$ × 50.



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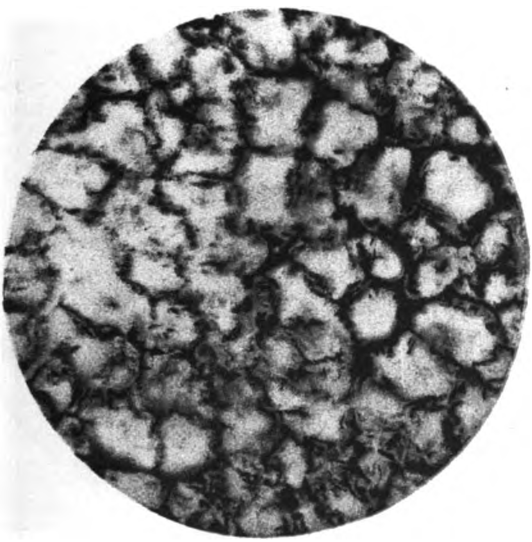

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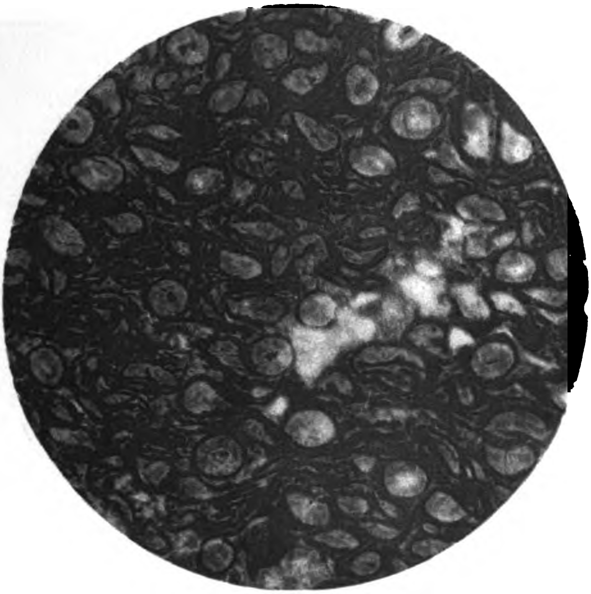

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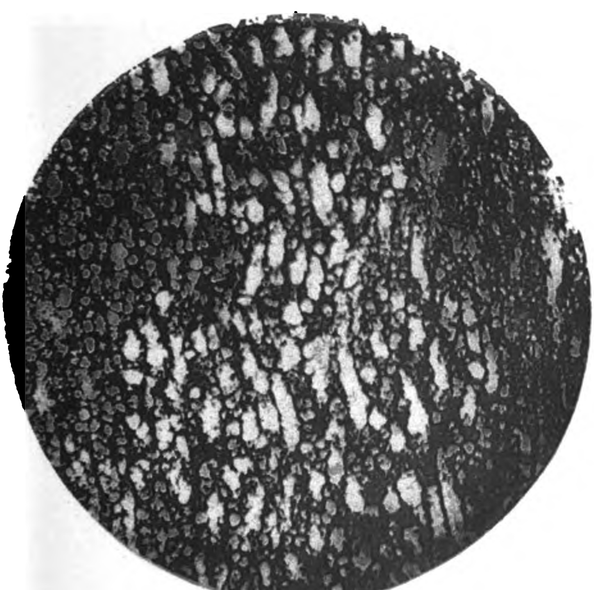

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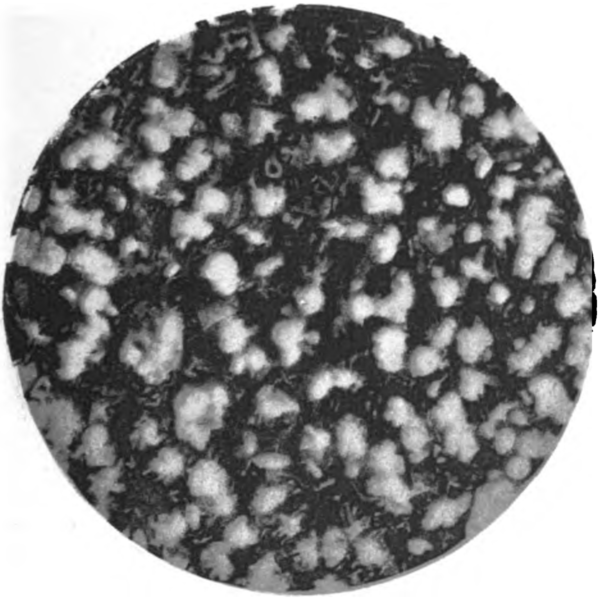

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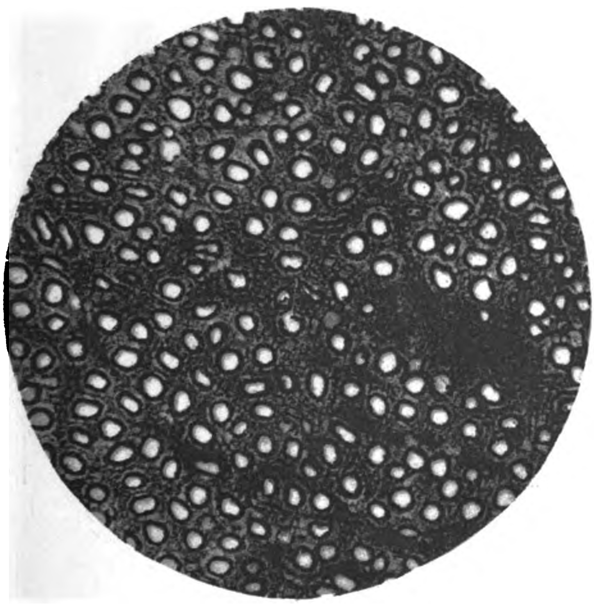

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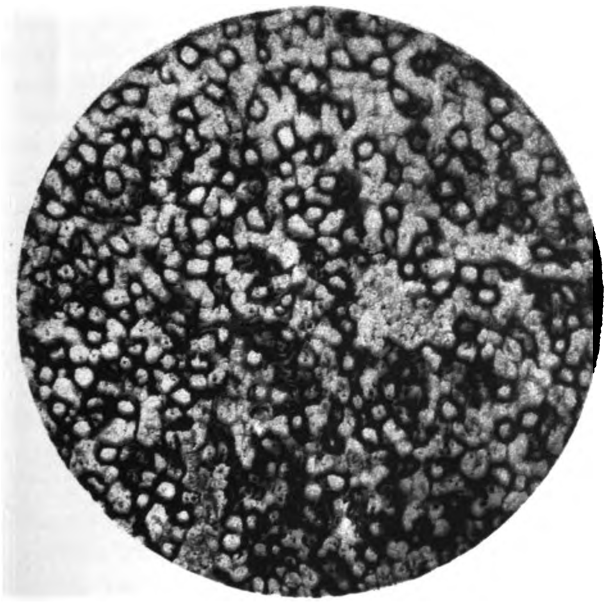

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A. Hoen & Co. Heliocaustic. Baltimore

Scientific results of explorations by the U. S. Fish Commission Steamer Albatross.

[Published by permission of Hon. Marshall McDonald, Commissioner of Fisheries.]

No. XXIII.—REPORT ON THE ACTINIÆ COLLECTED BY THE UNITED STATES FISH COMMISSION STEAMER ALBATROSS DURING THE WINTER OF 1887-1888.

BY

J. PLAYFAIR MCMURRICH, M. A., PH. D.

[With Plates XIX-XXXV.]

The collection which forms the subject of this report was forwarded to me soon after its arival in Washington, and I gladly availed myself of the opportunity thus presented of continuing the investigation of the deep-sea Actinians, which was so admirably inaugurated by Prof. Richard Hertwig. The studies of this distinguished naturalist have resulted in the establishment of a new and more correct basis for the classification of the Actiniæ, by calling to the aid of the somewhat uncertain external peculiarities, the more reliable characteristics revealed by a thorough anatomical study of each species. The revision of the Actinians in accordance with this new system of classification founded by Prof. Hertwig has been carried on by myself for the Actiniæ of the West Indies and by Prof. Haddon for the forms occurring on the coasts of Great Britain. Much has been added to our knowledge of many forms, and many errors have been corrected, and it has been my hope that the present study would clear away still further the mists that obscure the relationships of the various Actinian groups.

The present report deals with the Edwardsiæ, Protactiniæ, Hexactiniæ, and Ceriantheæ obtained by the *Albatross*. I hope in a future report to give the results of my studies of the Zoantheæ.

I gladly acknowledge the many courtesies I have received from my friend, Mr. Richard Rathbun, during the preparation of this report. I am indebted to him for the opportunity of comparing several specimens in the collection with allied and occasionally identical forms obtained by the Fish Commission steamers off the eastern coast of North America.

PART I.

THE CLASSIFICATION OF THE ANTHOZOA, AND ESPECIALLY OF THE ACTINIÆ.

What may be termed an approximately correct idea of the relationships of the various groups of animals now included under the term Anthozoa or Actinozoa can be said to have come in only with the begin-

ning of the present century, and to have had its first exponent in Cuvier. Earlier authors were led astray by the supposed vegetable character of the corals and similar forms, and later, by attaching too great importance to the presence or absence of a hard skeleton, whereby closely related forms were widely separated. Thus Linné in the twelfth edition of his "Systema" referred the genus *Actinia* to the Mollusca, the remaining Actinozoa being referred to two groups, the Lithophytes, which included the Madrepores, and Zoöphytes, which, in addition to the Alcyonaria, contained also sponges, Bryozoa, Sertularia, and Protozoa (*Vorticella*). Pallas (1766) improved this arrangement slightly by fusing the Lithophytes and Zoöphytes to a single group, but the genus *Actinia* he referred, along with the Echinoderms, to his group Centroniæ.

Cuvier by the foundation of the Radiata, a group containing, it is true, very heterogeneous members, did good service in bringing together more closely than previous authors the allied Anthozoa. The third class of the Radiata, the Acalephs, contained the genera *Actinia* and *Zoanthus* with which was associated *Lucernaria*, while in the fourth class, that of the Polypes, were grouped together the rest of the Anthozoa under the term "Polypes corticaux à polypiers." The tribes of this latter group with some of their principal genera are as follows:

Tribe 1 Ceratophytes=*Antipathes*, *Gorgonia*.
2 Lithophytes=*Isis*, *Madrepora*, *Millepora*.
3 Polypes nageurs=*Pennatula*, *Renilla*, to which were added *Orbulites*.
4 Alcyons=*Alcyonium*, *Spongia*.

It will be seen that the character of hardness or softness was given considerable weight in the Cuvierian system, leading to the association in the same tribe of an Alcyonarian, a Hexacorallian, and a Hydrozoon, and similarly to the separation of various Alcyonarian genera, according to their relative consistency. The separation of the Actinians from the Mollusca and their reference to the Acalephs is however a step in advance, though their true relationships were unperceived.

With contemporary and succeeding systematists these two features held firm ground. Lamarck (1818) though referring *Zoanthus* to the Polyps with *Hydra*, *Coryne*, etc., returns to the classification of *Actinia* with the Echinoderms as advocated by Pallas, being followed in this respect by Schweigger (1820), who makes the presence or absence of a hard skeleton the criterion according to which the Zoöphytes are referred to the *Z. monohyla* or *Z. heterohyla*, the former division containing Infusoria, Rotifera, *Zoanthus*, *Tubularia*, and the Alcyonids. The reference of the Actinians to one of the groups of the Polypes dates back to Lamouroux (1821), who still relying on the presence or absence of a skeleton divides the Zoöphytes into (1) Polypiers flexibles, (2) Polypiers pierreux, and (3) Polypiers sarcoides, the last group containing the Actinians together with the Alcyonids and the compound Ascidians.

Notwithstanding the heterogeneity of these groups, Lamouroux's classification paves the way for the more accurate systems that follow. Noticeable especially is that of de Blainville (1834), who associates together in Class III Zoanthaires of his Type Actinozoaires the Actinians, Zoanthans and Madrepores, thus cutting loose from the consistency systems of his predecessors. The remaining Anthozoa, together with the Hydroids, Millepores, and Bryozoa, he refers to the fourth class, Polypiaires.

Before de Blainville, however, Rapp ('29) had published a classification of the Polyps which, though not accepted by his successors, stands out, in the light of our present knowledge, as an evidence of the value of anatomical distinctions as a basis for classification. In his preface Rapp says: "Bei dem Studien der mit einem Gerüste oder Polypenstock versehenen Polypen war dieser Theil, indem man das Thier selbst vernachlässigte, bisher hauptsächlicher Gegenstand der Aufmerksamkeit. * * * Zwar fehlt es über diese Thiere nicht an trefflichen Beobachtungen, welche man hauptsächlich der neuesten Zeit verdankt, aber sie stehen bis jetzt meist noch zu isolirt, als dass sie auf die ganze Gestalt desjenigen Theils der Wissenschaft, welcher mit diesen Geschöpfen sich beschäftigt, einen durchgreifenden Einfluss gehabt hätten." To bring these isolated anatomical facts together, and to add to them was the task Rapp set himself, and as the result of his studies two important facts were brought to light. In the first place he recognized the near relationship of the Madrepores and the Actinians, and secondly he discovered the Actinian nature of the form previously described by him as *Tubularia solitaria*, now known by the generic name of *Cerianthus* proposed by Della Chiaje in 1832.

Rapp assumed as the basis of his classification the mode of formation of the reproductive organs. He found that some polyps produced ova on the outer surface of the body, while in others the "Keimkörner" had their origin in the interior; the former constitute his *Exoarier*, while the latter are referred to the division *Endoarier*. To the former division he assigned the Hydras, Corynes (including *Sertularia* and *Tubularia*) and Millepores(!), while to the latter were referred the Alcyonids, Tubipores, Corals (a group which included *Corallium*, *Gorgonia*, *Isis*, and *Antipathes*(?)*), Pennatulids, Zoanthids, Madrepores, and Actinians. Bearing in mind the fact already stated that Rapp associated the forms now known as *Cerianthus* with the Actinians, it may be seen that his division Endoarier is equivalent to the modern group Anthozoa, while his Exoarier corresponds essentially with the Hydrozoa, though he does not include within it the Hydromedusæ, whose relationships to the Hydroids had not been discovered.

It is interesting to note that in this classification Rapp forestalled the Hertwigs ('79), whose proposed division of the Cœlenterates into

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* The mark of interrogation is Rapp's.

Ectocarpæ and Endocarpæ is founded on the identical characteristic which Rapp chose, though the more recent authors define more accurately the place of origin of the reproductive elements in the terms of the germ-layers, structures unknown to Rapp.

Unfortunately, the systematists who immediately succeeded Rapp did not advance the position he had occupied. De Blainville's association of the Actinians with the Madrepores has already been noticed, a happy exception to the complicated confusion into which he falls as to other groups. On the whole, however, his classification must be considered an advance as compared with that of Ehrenberg ('34), who falls back to the old consistence system, though avoiding De Blainville's perpetuation of the earlier misconception of the Bryozoa as allied to the Zoöphytes. To Ehrenberg we owe the substitution of the term Anthozoa for that of Zoöphyta, employed by earlier writers, and this "circulus" he divides into two orders whose limitations may be seen from the following synopsis:

Circulus I.—Anthozoa.
  Ordo I.—Zoöcorallia.
    Tribus I.—Zoöcorallia polyactinia (Actinians, Zoanthans, and Fungidæ).
    Tribus II.—Zoöcorallia octactinia (Xenias, Tubiporids, Alcyonids, and Pennatulids).
    Tribus III.—Zoöcorallia oligactinia (Hydroids).
  Ordo II.—Phytocorallia.
    Tribus IV.—Phytocorallia polyactinia (Oculinids and Astræids).
    Tribus V.—Phytocorallia dodecactinia (Madrepores and Millepores).
    Tribus VI.—Phytocorallia octactinia (Corallium, Isids, and Gorgonids).
    Tribus VII.—Phytocorallia oligactinia (*Allopora*).

It will be seen from the above that the Zoöcorallia includes all those forms which are destitute of a hard skeleton, or which, like Fungia, possessing a corallum are not fixed, while the Phytocorallia embraces the forms provided with a hard skeleton, being at the same time fixed. Such a classification necessarily separates closely allied forms, as, for instance, the Fungidæ from the other Hexacorallia, and the Pennatulids from the Gorgonids. The group Anthozoa as conceived by Ehrenberg differs from the modern conception of the group in including the Hydroids and Hydrocorallinæ, in which respect Ehrenberg falls far behind Rapp, and in excluding the Antipatharia which are in this system referred to the Bryozoa. In one particular, however, Ehrenberg surpasses his predecessors, with the exception of Rapp, and that is in employing for his secondary groups characters which belong to the living animals. The number of the tentacles is a feature which within certain limits has been found to be associated with the features which mark out the various groups as now recognized.

The association of the various eight-tentacled forms into a single group was one of the important steps which now followed. According to a statement made by Dana ('46a) this was first done by Milne Ed-

wards,* who divided his group of the Polypes parenchymates into three groups:

Sertulariens. Zoanthaires.
Alcyoniens.

Of these the first group corresponds to the Hydroidea, the second to the Actiniaria and Hexacorallia, and the last to the Alcyonaria.

A most important classification appeared in 1846 as the result of the extended study of the Zoöphytes of the Wilkes exploring expedition by Prof. James D. Dana. His groups are as follows:

ZOÖPHYTA.

I. Order. Actinoidea.
 I. Suborder. Actinaria.
  I. Tribe. Astræacea—including the Actinians with which Lucernaria was associated and the Astreid and Fungid corals.
  II. Tribe. Caryophyllacea—including besides the Caryophyllids and Cyathophyllids, the Zoantheæ.
  III. Tribe. Madreporacea—including Madreporids, Favositids, to which are referred the Millepores and Poritids.
  IV. Tribe. Antipathacea.
 II. Suborder. Alcyonaria.
II. Order. Hydroidea.

It will be seen from this that the order Actinoidea is practically equivalent to the group Anthozoa of to-day, and that a clear distinction is made between the Actiniaria and the Alcyonaria. The former group includes all the Hexacorallia and the Actiniaria of later authors, as well as the Antipathacea, and it is interesting to note that Dana insists upon the unimportance of the stony corallum, grouping together, as De Blainville had done before him, the non-skeletogenous Actinians and the skeletogenous Hexacorallia.

One of the principal groups of the Anthozoa, the Alcyonaria, being thus delimited, and a second, the Antipatharia, also marked out, though not considered of equal value, it will be well to go back some distance and note the gradual discovery of various forms recognized now as distinct groups, but included so far as known in the first two tribes of Dana's Actinaria.

The earlier authors recognized a single genus of *Actinia* only, though other names,—*e. g.*, *Urtica*, *Hydra*, and *Priapus*—had been proposed. In 1801 Lamarck separated the genus *Zoanthus* for the form described by Ellis as *Actinia sociata*, and thus paved the way for the distinction which later authors made between this and similar forms and the Actiniæ proper. Cuvier also recognized the genus *Minyas*, referring it, however, to the Holothurians, its true position not being recognized until later by Lesueur ('17). A further division of the genus *Actinia* was inaugurated by Oken in 1815, who established the genera *Metridium* and *Cereus*, and set the example for the more accurate generic

*I take this statement from Dana, not having access to Milne-Edwards' work.

classification found in later authors. The large number of forms brought to notice by the scientific voyages of this period increased noticeably the number of Actinian genera, and in the classifications of De Blainville and Ehrenberg we find a considerable number of genera established.

Attention has already been called to the discovery of the Actinian character of *Cerianthus* by Rapp ('29), the subsequent application of the generic name by which it is now known by Della Chiaje. In 1841 Quatrefages ('41), in a paper which is a model of accurate observation and description, established the genus *Edwardsia* on essentially the same basis as that on which it now rests, though more recent observations have added certain particulars which the methods of microscopic investigation of the day have brought to light.

The year 1841 marks therefore the establishment of most of the groups of Actinaria which are now recognized, so far as they possessed generic value, but for some time *Cerianthus* and *Edwardsia* were considered of equal taxonomic value with *Actinia*, *Thalassianthus*, *Discosoma*, and other simply generic terms. The *Zoanthus* group formed to some extent, however, an exception to this rule, probably on account of their colonial habit of life and the power some possessed (*Palythoa*, *Corticifera*) of encrusting themselves with calcareous or siliceous particles, recalling by their consistency skeletogenous forms. Their gemmiparous reproduction induced Dana to group them apart from the rest of the Actinians, and associate them with the Caryophyllid corals.

To give a résumé then of the state of Anthozoan taxonomy at the middle of this century it may be said that the group was definitely delimited, the Bryozoa having been excluded in accordance with the observations of Milne-Edwards. The Alcyonarian forms had been grouped together from their earlier separation into a number of groups each equivalent to the Hexacorallia, Actiniæ, etc. The Antipatharia were referred to the Anthozoa, and even constituted a group of slightly less value than the Alcyonaria. And lastly, the Actiniæ had been divided into a number of genera and associated with the Hexacorallia, the similarity of structure of the animals themselves being considered of greater moment than the possession or absence of a corallum.

A new era in Anthozoan classification was introduced by the publication in 1857 of the first two volumes of Milne-Edwards' *Histoire naturelle des Coralliaires*. In some respects, notably in the severance of the Madrepores from the Actinians, a backward step was taken which has been maintained up to a comparatively recent date, but on the other hand, a decided advance was accomplished in the more accurate delimitation of several groups, and in the recognition of groups of genera among the Actinians.

Milne-Edwards recognized Leuckart's division of the Cuvierian Radiata into the two groups Echinodermata and Coelenterata, and divided the latter into two classes, the Acalephs, including three sub-classes,

i. e., the Medusæ, Siphonophores, and Hydroids, and the Coralliaires. The Coralliaires he again subdivided as follows:

Class Coralliaires.
  Sub-class Cnidaria.
    Order Alcyonaria.
    " Zoantharia.
      Sub-order Zoantharia malacodermata or Actinaria.
        Zoantharia sclerobasica or Antipatharia.
        Zoantharia sclerodermata or Madreporaria
  Sub-class Podactinaria (=Lucernaria).

It will be seen from this that Milne-Edwards's class Coralliaires is equivalent to Dana's order Actinoidea, and his sub-class Cnidaria to Dana's Actinaria *minus Lucernaria*, a step toward the separation of this genus from the Anthozoa, and its reference to the modern group of the Scyphozoa. In his division of the Zoantharia, however, Milne-Edwards retrogrades towards the older consistence systems of Lamouroux and Ehrenberg.

So far as the Actinaria are concerned Milne-Edwards did excellent service in delimiting the various genera that had been proposed, in dividing these up in some cases, and establishing new genera, such as *Paractis*, *Phymactis*, *Oulactis*, etc., and in grouping similar genera together, forming families, sub-families, etc. His larger divisions are as follows:

1. Family Actinidæ.
   1. Sub-family Minadæ.
   2. Sub-family Actininæ.
   3. Sub-family Thalassianthinæ.
   4. Sub-family Phyllactinæ.
   5. Sub-family Zoanthinæ.
2. Family Cerianthidæ.

The sub-family Actininæ was again subdivided into sections, thus:

1. Actinines vulgaires—including forms with smooth walls and adherent base.
2. Actinines verruqueuses—including forms with tubercles or verrucæ upon the column.
3. Actinines perforèes—corresponding to the family Sagartidae of more recent systems.
4. Actinines pivotantes—including forms which do not possess an adherent base.

In analyzing this classification in the light of our present knowledge of the relationships of the Anthozoan groups we note a recognition of most of the modern taxonomic groups, with, however, very unequal values attached to them. Thus the Alcyonaria constitute a group equivalent to all the others taken together; the Antipatharia, another of equal value with all that still remains; the Cerianthidæ are recognized as a family equal in value to all the other Actinians; while the Zoanthinæ are equivalent only to the Thalassianthinæ, etc. The Edwardsiæ do not have a group value, being recognized simply as a genus of Actinines pivotantes, where they are associated with *Ilyanthus*, *Peachia*, and *Sphenopus*, the last belonging properly to the Zoan-

thinæ. In choosing the relative consistency of the various forms as a basis for his division of the Zoantharia Milne-Edwards naturally falls into certain of the errors which such a classification entails, and which had been handed down from earlier days, as for instance the grouping of the Millepores with the Madreporaria. In this, however, there is neither loss nor gain, since none of his predecessors, with the conspicuous exception of Rapp, had suggested the reference of these forms to their proper position. The principal error of the classification, as already pointed out, lay in the attaching of too great importance to the presence or absence of a corallum, and in the disregard of the similarity of the soft parts of Madreporaria and Actinaria so definitely stated by Dana.

Milne-Edwards's classification had a marked influence upon later writers, most of whom adopted his larger divisions, the principal modifications introduced by them affecting the arrangement and definition of the lesser groups. An exception to this, however, was the classification of Gosse ('60) who adhered to the arrangement laid down by Dana, but went a little further than that author in dividing certain of the tribes of Actinaria into families, thus:

Suborder Actinaria—
- Tribe I. Astræacea:
  - Family I. Metridiadæ = forms with compound tentacles.
  - II. Sagartiadæ = with simple tentacles, adherent base, and column pierced by cinclides.
  - III. Antheadæ = column smooth and imperforate, margin simple.
  - IV. Actiniadæ = margin beaded.
  - V. Bunodidæ = column warted.
  - VI. Ilyanthidæ = base non-adherent, rounded, simple.
  - VII. Minyadidæ = base non-adherent inclosing an air chamber.
- Tribe II. Caryophylliacea:
  - α. Without a corallum.
    - Family I. Capneadæ = simple.
    - II. Zoanthidæ = compound.
  - β. With a corallum, certain corals divided into four families.

The coralligenous Astræacea Gosse does not classify, none of the genera being British, nor does he divide the Madreporacea or Antipathacea into families, for the same reason. The Lucernariadæ he excludes from the Actinaria, recognizing their affinities to the Medusæ.

On comparing this classification with that of Milne-Edwards, it will be seen that, independently of the association of non-coralligenous and coralligenous forms, there is a very different grouping of the genera. The family Metridiadæ (a name badly chosen) is equivalent to Milne-Edwards's Thalassianthinæ and Phyllactinæ, the Sagartiadæ are the Actinines perforées, and the Bunodidæ the Actinines verruqueuses, both raised to the rank of families. The Actinines vulgaires are divided into three families, two of which, the Antheadæ and Actiniadæ belong to the Astræacea, while the third, the Capneadæ, is referred, with the Zoanthidæ, to the Caryophylliaceæ, while Milne-Edwards's

family Cerianthidæ is abolished, *Cerianthus* and *Arachnactis* being associated with his Actinines pivotantes to form the family Ilyanthidæ. These comparisons refer to the broad features of the groups, there being differences in detail in some. Many new genera were established by Gosse, as for instance, *Bolocera*, *Bunodes* and *Aiptasia*, and this, as well as his disregard for the most part of non-British forms, renders it difficult to make a detailed comparison between the two authors.

By the exclusion of the Lucernariadæ the Anthozoa obtained the limitations which they now possess, except that the Hydrocorallines still continued to be referred to the group. Agassiz indeed upheld their hydroid character, but it was not until Moseley's brilliant observations ('78) were made, that they were definitely assigned to the position long before pointed out for them by Rapp.

As already stated, subsequent authors were more influenced by Milne-Edwards than by Gosse in drawing up their classifications, though the division into smaller groups was not unlike that proposed by the latter. Gosse's smaller divisions were more or less adopted and subordinated to Milne-Edwards's system. It will be altogether unnecessary to refer to all the classifications presenting these features, but still it will be convenient to give one or two examples, choosing those which present most historical value.

One of these may be the classification proposed by Verrill in 1865, which outdoes even that of Milne-Edwards in placing inordinate importance upon the corallum. Verrill divides the Cnidaria or Polypi into 3 orders, *i. e.*, (1) Madreporaria, (2) Actinaria, (3) Alcyonaria, the increase from the number proposed by Milne-Edwards being accomplished by raising the Madreporaria from the subordinate position they occupied in the order Zoantharia and making them of equivalent rank with the Alcyonaria. The division of the Actinaria which Verrill proposed was as follows:

Suborder I. Zoanthacea.
  Families. Zoanthidæ and Bergidæ.
Suborder II. Antipathacea.
  Families. Antipathidæ and Gerardidæ.
Suborder III. Actinacea.
  Families. Actinidæ, Thalassianthidæ, Minyidæ. Ilyanthidæ, Cerianthidæ.

This arrangement is important in giving the Zoanthids a greater importance than had hitherto been assigned to them, and in separating the Cerianthidæ from the Ilyanthidæ, though they do not receive the same position that Milne-Edwards gave them. The family Actinidæ Verrill divided in various subfamilies, differing somewhat from the equivalent groups of Gosse and Milne-Edwards, a subfamily Phellinæ being established for the genus *Phellia*. Milne-Edwards' Phyllactinæ and Thalassianthinæ he unites together in his family Thalassianthidæ, which is subdivided into the subfamilies Phyllactinæ, Thalassianthinæ, Heterodactylinæ and Discostominæ (Verrill, '68), the members of

the last named subfamily having the tentacles arranged in radiating rows, more than one tentacle communicating with an intermesenterial space. The establishment of this peculiarity is important, as it is a character which approximates the Actinaria with the Madreporaria.

To the Discostominæ Verrill referred the genera *Discosoma* and *Corynactis*, classed by Milne-Edwards with the Actinines vulgaires, and *Capnea* and *Aureliana*, referred by Gosse to the Caryophylliacea.

The classification of Klunzinger ('77) may now claim our attention as showing a further step toward a correct differentiation of the groups. The classification is to a very large extent similar to that of Verrill, but contains certain important innovations. The Madrepores are, following Milne Edwards, considered a separate group, and the remaining groups are as follows:

I Or. Alcyonaria.
II Or. Antipatharia.
III Or. Zoantharia—including the Zoanthidæ.
IV Or. Actinaria.
- 1. Family Actinidæ.
  - 1. Subfamily Actininæ.
  - 2. Subfamily Phellinæ.
  - 3. Subfamily Sagartinæ.
  - 4. Subfamily Bunodinæ.
- 2. Family Ilyanthidæ.
- 3. Family Cerianthidæ.
- 4. Family Discosomidæ.
- 5. Family Thalassianthidæ.
  - 1. Subfamily Phyllactinæ.
  - 2. Subfamily Thalassianthinæ.

The first noticeable feature of this classification is the separation of the Antipatharia and Zoantharia from the Actinaria, and the elevation of their rank to that of groups equivalent to the Alcyonaria. Furthermore, among the lesser groups there is the separation of the Discosomidæ from the Thalassianthidæ, with which Verrill associated them, the radiate arrangement of the tentacle being the characteristic feature of the family. Klunzinger, however, failed to associate the genus *Corynactis* with *Discosoma*, stating definitely that its tentacles alternate with each other. The other families and subfamilies are essentially the same as those of Verrill, except that no mention is made of the Minyadæ.

We come now to the monograph of the Actiniaria by Andres ('83), which must ever remain a monument to the industry of its author, to whom all actinologists are indebted for placing in their hands such a carefully collated and complete list of the Actinians known up to 1880. Unfortunately for our purpose, Andres does not express his ideas as to the relationships which his Actinaria bear to the Alcyonaria and Antipatharia, but confines his attention solely to the *Zoantharia mala-*

codermata of Milne Edwards. He divides the group into seven families, thus:

Edwardsinæ.	Zoanthinæ.
Actininæ.	Cerianthinæ.
Stichodactylinæ.	Minyadinæ.
Thalassianthinæ.	

The names of the majority of these groups indicate their limitations; the greatest innovations are the separation of the Edwardsias from the Actininæ and the establishment of the Stichodactylinæ. This family possesses for its distinguishing character the feature upon which Klunzinger based his family Discosomidæ, *i. e.*, the radiate arrangement of the tentacles, but at the same time it is made much more comprehensive, the Phyllactinæ of Klunzinger being associated with *Discosoma*, *Capnea*, *Aureliana*, *Phymanthus* and other genera, all of which possess radially arranged tentacles. The Thalassianthinæ is, consequently, poor in genera compared with Klunzinger's Thalassianthidæ, containing only a few forms with large compound tentacles. Four of Andres' groups are certainly well established, namely, the Edwardsinæ, Actininæ, Zoanthinæ and Cerianthinæ. He was influenced, however, too much by the arrangement and structure of the tentacles in making the Stichodactylinæ and Thalassianthinæ equivalent to these four; they should more properly be made subgroups of the Actininæ. The same remark applies, perhaps, to the Minyadinæ, though we are still in ignorance as to the structural peculiarities of its members. The fact that some of the species evidently have their parts arranged on a hexamerous plan favors this view, and the occurrence of others possessing a decamerous arrangement can not be considered as of great weight in favor of keeping them distinct, in view of the same symmetry occurring in the Halcampidæ, for instance, and in other sporadic instances in which there can be no question as to the advisability of associating the forms with their hexamerous relatives in the Actininæ. In fact, it seems probable that the Minyadinæ are not even to be given a value equal to the Stichodactylinæ, but are rather to be referred to the Halcampidæ, a family or subfamily of the Actininæ.

The disappearance of the Ilyanthidæ from the list of families is an important point also. Andres has diminished the importance of trivial characters in accomplishing this, and has emphasized the importance of the numerical relations of the parts as a basis for classification in separating from them the Edwardsias and referring the thus restricted groups to the Actininæ.

Andres enters into a much more minute division of his families into subfamilies, many of which are well founded, but it will not be convenient to criticise them here.

With Andres the second period in the history of the classification of the Anthozoa may be said to close. The period was marked by a gradually growing tendency to divide the group into a number of

equivalent subgroups, and, so far as the Actinians are concerned, by the increase in the number of recognized genera and their division into families, subfamilies, etc. The distinguishing characters of the various groups were drawn for the most part from external characters; importance, for instance, being placed upon the presence or absence of a corallum, whether the base is adherent or not, in the shape of the tentacles, etc. Comparatively little was done toward attaining a thorough knowledge of the anatomical relationships of the various parts, or perhaps it would be better to put it in this way, that the anatomical knowledge that had been acquired was not sufficiently extensive to be employed for systematic purposes. The names of Hollard, Quatrefages, Haime, Thorell, Teale, Schneider and Rotteken, Stoliczka, etc., recall important additions to our knowledge of Actinian morphology, but the observations were not sufficiently extended to have suggested the importance that should have been attached to them.

We are now in the third period, so brilliantly introduced by the brothers Hertwig with their monograph on the Actinians ('79). The period in its beginning overlaps, consequently, the second period. The fundamental characteristic of Actinian classification at present is the foundation which it possesses on anatomical and phylogenetic features. The arrangement of the mesenteries and their ontogenetic succession are the criteria which serve to separate the larger groups, and these criteria have been extended, so far as our present knowledge allows of it, to the group Anthozoa as a whole. The first step in this direction, as stated, was made by the Hertwigs ('79), who, as a result of their observations on a number of Actiniaria, arrived at the following conclusion:

Bei der Eintheilung der Anthozoen sind die Septen in erster Reihe zu berücksichtigen, aber weniger die Zahl als vielmehr der Bau, die Anordnung derselben um das Schlundrohr und ihre Entwicklung. Wenn wir von dieser Grundlage ausgehen, werden die Anthozoen voraussichtlich in mehr als 2 Ordnungen zu zerfällen sein. Mit Erfolg aber kann ein neues System erst dann aufgestellt werden, wenn die verschiedenen Familien der Zoantharien, der Fleischpolypen sowohl als der Korallen, auf die Morphologie ihrer Septen, über die wir vielfach noch gar nichts wissen, nach allen Richtungen untersucht sein werden.

The Hertwigs recognize five groups of Anthozoa, based on the characters indicated in the above quotation, viz, the Actinidæ, Edwardsiæ, Zoanthidæ, Cerianthidæ, and Alcyonaria. As regards the Madreporaria, they do not commit themselves definitely, recognizing the paucity of the information with regard to their anatomical peculiarities at their disposal; at the same time, however, they consider it probable that when the required information is acquired the group of the *Zoantharia sclerodemata* will be split up, a large part of the corals being associated with the Actinidæ, others, perhaps, with the Zoanthinæ, and others with Edwardsiæ, while others, again, may show an arrangement and structure of the mesenteries peculiar to themselves.

The idea brought forward in this work was elaborated more fully by Richard Hertwig in his report on the Challenger Actiniaria ('82), in which the structural peculiarities of the various forms are employed, not only to distinguish the principal groups, but also to define in an accurate manner the various families of the Hexactiniæ. In some particulars the idea was carried a little too far, owing to the absence at that time of anatomical studies of a large series of forms, Hertwig being obliged to rely entirely on his own observations in deciding as to the relative importance of a character. Omitting the Alcyonaria and Antipatharia from consideration, Hertwig recognizes six tribes of Actiniaria, which correspond in taxonomic value to Andres's families. These tribes are (1) Hexactiniæ, (2) Paractiniæ, (3) Monauleæ, (4) Edwardsiæ, (5) Zoantheæ, and (6) Cerianthea, and all are characterized by the arrangement of the mesenteries. Three of these orders correspond to families of Andres' classification; other three of Andres' families, viz; Thalassianthinæ, Stichodactylinæ, and Minyadinæ are grouped with his Actininæ to form the tribe Hexactiniæ, while two other tribes, not represented in Andres' system, are instituted for forms presenting an arrangement of the mesenteries not previously recognized. In comparing the systems of Hertwig and Andres, however, it must be remembered that the two works were so nearly contemporaneous that the respective systems were entirely independent one of the other. Andres, it is true, had the advantage of the earlier work of the brothers Hertwig ('79), which no doubt influenced considerably his ideas as to the relationships of certain of the groups, but had no cognizance of Richard Hertwig's later observations.

The introduction into the classification of the Anthozoa of a system based upon anatomical peculiarities, instead of one resting entirely on variable characters, readily subject to modification in accordance with external conditions, was very important. There yet remained to be taken the further step of adding to anatomical characters the information derived from embryological investigation, a step the importance of which the Hertwigs had recognized and contributed to, to a certain extent. Some of the necessary information was contributed later by Boveri ('90) and myself ('91), and as the result of these observations I drew up a classification of the Anthozoa founded upon structural and embryological characteristics. Either of these classes of facts, taken by itself, is liable to lead to errors; it is only by combining both that a true knowledge of the phylogenetic relationships of the various groups can be obtained. For instance, relying entirely on embryological data, the Hexactiniæ could be separated into three distinct groups, one including those forms in which the mesenteries appear according to the succession described by Lacaze-Duthiers; a second, in which the mesentery succession is that described by the Hertwigs ('79); and a third, in which it is that described by Haddon ('87), H. V. Wilson ('88), and myself ('91). I have shown, however ('91 *a*), that the third

method is to be regarded as the typical one, and that the orders of succession described by Lacaze-Duthiers and the Hertwigs are secondary modifications of this, called forth by peculiar conditions; and, furthermore, anatomical investigation of forms developing in these various manners shows so much similarity in them all as to do away with any idea of classing them in three distinct groups.

The classification which I proposed differs from that of Hertwig in two particulars. In the first place I disregard his tribe Paractiniæ, which I have shown to be unnatural and untenable, and I group the form upon which his tribe Monauleæ was founded with the *Gonactinia*, long before described by Sars and later studied more thoroughly by Blochmann and Hilger ('88), and with the *Oractis Diomedeæ*, described in subsequent pages of this report, forming thus a tribe, the Protactiniæ, the members of which I take to represent stages in the phylogeny of the Hexactiniæ. Strictly speaking, perhaps each of these three forms should constitute an order, but is seems to contribute to the convenience of the classification, without introducing any confusion, to group them together. I recognize the following tribes of Anthozoa:

1. Rugosæ.	5. Ceriantheæ.
2. Antipatharia.	6. Zoantheæ.
3. Alcyonaria.	7. Protactiniæ.
4. Edwardsiæ.	8. Hexactiniæ.

The propriety of considering the Rugosæ as forming a tribe equivalent to the Alcyonaria, for instance, is open to question, since we naturally know nothing as to their soft parts and can only form an exceedingly uncertain idea of how they were arranged from the arrangement of the septa in the corallum. The Antipatharia form a natural group, apparently, though it is uncertain what their affinities with the other groups may be. The remaining tribes seem to have their phylogenetic relationships fairly clearly defined.*

* In a recent paper Ed. van Beneden ('91) contests the idea that there is a phylogenetic connection between the Ceriantheæ and the Edwardsiæ and Hexactiniæ. On pages 140–141 of his paper he sums up the differences which the Ceriantheæ show to these forms, and it may not be out of place here to consider the value of these supposed differences. Difference No. 1 does not require consideration, since it stands or falls with the accuracy or erroneousness of No. 2. This is as follows: If the sulcar directives are designated as I and the remaining mesenteries of a twelve-mesenteried Hexactinian are designated according to their succession, counting from the sulcar directives towards the sulcular, as II, III, IV, V, and VI, then the embryonic succession of the mesenteries in the Hexactiniæ is III, V, I, VI, II, IV, while in the Ceriantheæ the succession of the first twelve mesenteries is II, III, I, IV, V, VI. The fallacy of this is evident. It has not been claimed that the first *twelve* mesenteries of Ceriantheæ and Hexactiniæ are homologous, but only that the first *eight* in both groups are homologous with the eight *Edwardsia* mesenteries. Considering the embryonic succession of these mesenteries in both groups, it will be found to be identical, thus: III, I, II, IV. Difference No. 3 refers to the presence of longitudinal (adductor) muscles on the mesenteries of the Edwardsiæ and Hexactiniæ and their absence on those of the Ceriantheæ, and to the presence of ectodermal longitudinal

A detailed criticism of the various families which have been proposed is not necessary, since this will be entered into in the descriptive portion of the report, so far as certain families of the Hexactiniæ are concerned. Andres ('83) added a considerable number of families to those which had previously been recognized, and the majority will, no doubt, stand. Hertwig too has added a number of new families, and at the same time has given an interesting criticism of Andres' classification and a comparison of it with his own. Many of the families Andres recognized are more accurately defined, and attention has been called to the criteria upon which families should be based. One of the most recent classifications, is that of Danielssen ('90), which is essentially that of Hertwig ('82), confused, and without the corrections, which Hertwig ('88) subsequently introduced. In fact, it must be acknowledged that Danielssen's work is a great disappointment, in that the descriptions are given in such a manner as to preclude confidence in their accuracy, while the figures illustrating them are beautiful examples of "how not to do it." The tribe Ægireæ, which Danielssen proposes, certainly requires further study before being accepted, and the same remark applies to his families Sideractidæ, Madoniactidæ, and Andvakidæ.

I shall content myself with stating the families which I believe to be worthy of recognition, making some brief remarks on their limitations, and on certain somewhat doubtful forms.

I think it convenient to consider the mode of arrangement of the tentacles of classificatory importance, and to recognize two subtribes of the Hexactiniæ to which Andres' name may be applied: Actininæ to those to which the tentacles are arranged in cycles, and Stichodactylinæ to those in which they are arranged radially. To these two I added ('89) a third, the Dendromelinæ, which is hardly of equal value, and which it will be better to reduce to the rank of a family. It includes forms which possess dendritic or globular processes or arms projecting from the column wall below the margin, such as are found, for instance, in *Lebrunea*, *Ophiodiscus*, and *Viatrix*.*

The Thalassianthinæ I would not, however, adopt as a subtribe, since they differ from the Actininæ only in the compound character of their tentacles, and a passage to them is furnished by the member of Andres' subfamily Heteractidæ. This family is; however, not altogether natural since the genus *Ragactis* must be removed from it and referred to the

muscles in the latter and their absence in the other two groups. The absence of "adductor" muscles in the Ceriantheæ is a question of observation, since Boveri has described and figured them; and with regard to the presence of ectodermal longitudinal muscles in the Hexactiniæ, van Beneden has apparently overlooked Hertwig's account ('88) of their occurrence in *Corynactis* sp? and *Corallimorphus obtectus*. In the present report I describe their occurrence in *Halcurias pilatus*.

*It seems fairly certain that the actinian recently described by H. V. Wilson ('90) as *Hoplophoria coralligens* (*sic*) is identical with the *Viatrix globulifera* originally described by Duchassaing and Michelotti ('60).

Sagartidæ, as was demonstrated to me by the late Dr. J. I. Northrup, who discovered the Sagartian character of *R. lucida*, an observation I have since been able to confirm.* The genus *Eloactis* also proposed by Andres ('83) for the *Ilyanthus mazeli* of Jourdan ('80) seems to belong rather to the Halcampidæ, *E. Mazeli* being apparently nearly related to *H. producta* of Stimson.

The following is the classification I suggest:

- A. Tentacles arranged in cycles. Actiniinæ.
  - Column simple.
    - Tentacles cylindrical, smooth.
      - Sphincter absent or weak endodermal
        - Mesenteries not numerous.. Halcampidæ.
        - Mesenteries numerous........ Antheadæ.
      - Sphincter endodermal; tentacles deciduous .... Boloceridæ.
      - Sphincter mesoglœal
        - No acontia.......... Paractidæ.
        - Acontia.............. Sagartidæ.
      - Sphincter endodermal circumscribed.
        - Acrorhagi wart-like. Bunodidæ.
        - Acrorhagi foliate. Phyllactidæ.
    - Tentacles warty or branched
      - Tentacles simple . Heteractidæ.
      - Tentacles compound . Thalassianthidæ.
    - Tentacles reduced to stomidia.................. Polyopidæ. Sicyonidæ.
  - Column provided in its upper part with branched or globular processes .... Dendromelidæ.
  - Free-swimming forms .... Minyadæ.
- B. Tentacles arranged radially. Stichodactylinæ.
  - Tentacles all of one form.
    - Tentacles few, capitate.... Corallimorphidæ.
    - Tentacles numerous, cylindrical .... Discosomidæ.
    - Tentacles nodulated .... Aurelianidæ.
  - Tentacles of two forms.
    - Marginal tentacles cylindrical; disc tentacles wart-like, branched, or foliate .... Rhodactidæ.
    - Marginal tentacles pinnate, disc tentacles wart-like.. Phymanthidæ.
  - Tentacles of various forms, not cylindrical... Criptodendridæ.

I have chosen the term Halcampidæ in preference to that of Ilyanthidæ because we are at present ignorant of the anatomical characteristics of *Ilyanthus*; it will, however, probably prove to be similar to *Halcampa* in many respects, in which case the older term should be restored. The Siphonactinidæ, I think, should be fused with the Halcampidæ, the presence or absence of a conchula not being of sufficient moment for family distinction.

The Boloceridæ is a new family, for whose existence reasons will be given in Part II. The Antheomorphidæ of Hertwig ('82) I include

* It seems doubtful, however, if the *R. pulchra* of Andres is likewise a Sagartid. I should rather be inclined to consider it a *Phymanthus*, since it presents certain striking resemblances, judging from Andres' description, to *P. crucifer*.

for the present with the Antheadæ. My reasons for placing the Phyllactidæ among the Actininæ have been given in another place ('89a). Hertwig's Polyopidæ and Sicyonidæ I have placed in the Actininæ, not recognizing his tribe, Paractiniæ. These forms require further study. The Liponemidæ are too much open to suspicion to be accepted, as will be seen from what is said in Part II concerning *Bolocera brevicornis*, *Liponema* recalling strongly a *Bolocera*, while *Polysiphonia* recalls *Actinernus*.

Under the Sagartidæ is included the Phellidæ, which may be regarded as a subfamily under Haddon's name of Chondractininæ, and the Amphianthidæ, which are probably all referable to the Sagartidæ and to the subfamily Chondractininæ.

The Minyadæ are inserted with the Actininæ as a family, but little is as yet known of their anatomical peculiarities.

The classification of the Stichodactylinæ hardly calls for comment, except to point out that, of the Aurelianidæ and Criptodendridæ very little is known, nothing indeed as to anatomical characters. I have employed the form of the tentacles, following Andres with modifications, as a basis for the classification; but in those groups members of which have been studied it has been found that more or less definite anatomical features are associated with the various tentacular modifications.

This classification is, it must be understood, intended to be purely tentative and to take cognizance only of families which seem well authenticated. No doubt the changes and additions which will be required to make it at all accurate are numerous—how numerous future observation will determine.

Part II.

DESCRIPTIVE.

Tribe EDWARDSIÆ, Hertwig.

Actinozoa not forming colonies; with eight mesenteries, three of which on each side have their longitudinal muscles upon their sulcar faces, while the other two, situated at the sulcar surface, have these muscles on their sulcular faces. Tentacles simple, usually more numerous than the mesenteries.

Genus EDWARDSIA, Quatrefages.

With the characters of the tribe.

I do not consider it necessary at present to divide the Edwardsias which we know into two genera, as Andres ('83) has done, much less to make the number of the tentacles the feature upon which to base such a division, since this is a character liable, to judge from the descriptions of species which we possess, to numerous gradations. When a thorough anatomical study has been made of a number of different

species, it may be found advantageous to make a division; at present it does not seem advisable.

1. Edwardsia intermedia, sp. nov.

Plate XIX, Figs. 1–4.

No. 704. Station 2783. Lat. 51° 02′ 30″ S.; long. 74° 08′ 30″ W. Depth 122 fathoms. 1 specimen.

The single specimen for which I propose the above name was strongly contracted, the entire capitulum being introverted. In this contracted condition (Pl. XIX, Fig. 1.) it measured 1.7^{cm} in height, and its greatest diameter is 0.45^{cm}.

The physa is rounded and translucent, allowing the mesenteries to show through. The scapus is covered by a thin, brown, chitin-like "epidermis," resembling, apparently, that covering *E. Claparedii*, but unlike it, being almost smooth. It is quite translucent and consists of two layers (Pl. XIX, Fig. 4); on the outside is a thin layer of foreign matter (*f*), consisting of very fine sand particles, spicules, etc., and below this a cuticle-like layer (*cu*) covering the ectoderm (*ec*) and sending here and there into that layer prolongations which seemed occasionally to unite with the mesoglœa. The arrangement is very similar indeed to what I have described for *Zoanthus sociatus* ('89), though it is not so certain in this case that the cuticle is really a portion of the mesoglœa. The ectoderm (Pl. XIX, Fig. 4, *ec*) consists of cells, not at all columnar, as is usually the case in the Actinozoa, and shows no trace of either gland cells or nematocysts.

The scapus is marked by eight longitudinal furrows, corresponding to the insertions of the mesenteries, and the intervals between these furrows are occupied by numerous irregularly scattered clear spots, which recall the tubercles described by Andres ('80) and Danielssen ('90). Their structure is, however, somewhat different from what these authors have described. The ectoderm over a small area is slightly thickened and projects through the covering investment, but no nematocysts were to be found in it. The transparent appearance which is so characteristic of the tubercles is due to a comparatively large oval cavity in the mesoglœa, lying below the tubercle and always separated, apparently, by a very delicate layer from the ectoderm, though a small collection of granules and, in some cases, a few cells are to be found in the cavity. (Pl. XIX, Fig. 4).

In transverse sections it is seen that a portion of the scapus is introverted as well as the entire capitulum; sections taken at a little more than 3^{mm} from the upper extremity of the contracted animal show the cuticular investment which is characteristic of the scapus. In this introverted region, however, the layer of foreign material (Pl. XIX, Fig. 2, *f*) is very much thicker than on the outer surface of the body, and, furthermore, in each interval between the insertions of two mesenteries a

strong ridge, formed principally of mesoglœa, projects, and as the capitulum is approached cavities appear in the ridge, giving it in cross-section a club-shaped outline.

The capitulum is apparently very short and is destitute of any investment. The number of the tentacles I could not ascertain, but they seem to be few, perhaps eight, almost certainly not more than sixteen. They project down into the stomatodæum in the manner described by Quatrefages ('41).

The stomatodæum is short and is slung by the eight mesenteries, whose musculature has the usual arrangement. All the mesenteries are gonophoric and possess mesenterial filaments. Since Andres ('80) has stated that in *E. Claparedii* the respiratory portions of the filament are wanting, I may state that in the species here described they are unmistakeably present, though short. The bases of the mesenteries at their insertion into the column wall are furnished with pinnately arranged muscle processes (Pl. XIX, Fig. 3 *b m*). The longitudinal muscles are strong, resembling in transverse section those of *E. tecta* as figured by Haddon ('89).

It is impossible to identify this form with any of the species that have been described. Within recent years a number of Edwardsias from deep water have been described by Moseley ('77), Marion ('82), R. Hertwig ('88), and Danielssen ('90), but the descriptions are not in all cases sufficiently detailed to permit of a correct idea of the morphological characteristics. The structural features which are of importance for classificatory purposes seem to be the tubercles, the shape of the longitudinal and basal muscles of the mesenteries, the presence or absence of longitudinal ridges on the column, and, what is probably of less importance, the number and arrangement of the tentacles.

E. intermedia agrees, as already stated, with *E. tecta* (Haddon, '89) in the structure of the longitudinal muscles, but differs from it in possessing tubercles and in the shape of the basal muscles of the mesenteries; it approximates *E. fusca* Danielssen ('90) in the number of the tubercles, though they are not arranged with anything like the regularity which they have in Danielssen's figure, and in addition the shape of the longitudinal muscles is altogether different; it resembles *E. carnea* (Haddon, '89) in the possession of longitudinal ridges on the capitulum and upper part of the scapus, but differs from it altogether in the shape of both longitudinal and basal muscles.

In consequence of its possessing certain of the characteristics of each of these three species I have named the form here described *E. intermedia*.

Tribe PROTACTINIÆ.

Anthozoa with twelve primary mesenteries, of which eight at least are perfect, and which are arranged in pairs, the longitudinal mesenteries of each pair being on the faces of the mesenteries which are turned

towards the intramesenterial space, except in the case of two pairs, the directives, situated at the extremities of the sagittal axis of the stomatodæum, whose longitudinal muscles are on the faces of the mesenteries which look towards the adjacent intermesenterial space. In addition to these primary mesenteries secondary mesenteries are also present; of these there may be one on each side, situated in the sulculo-lateral intermesenterial space, or a pair on each side in the same intermesenterial space, or two pairs on each side in the sulculo-lateral and lateral intermesenterial spaces. The development of the mesenteries is upon a bilateral plan.

Genus ORACTIS, gen. nov.

Protactiniæ with twenty mesenteries, twelve of which are primary, and two pairs on each side, in the sulculo-lateral and lateral intermesenterial chambers respectively, secondary. Only the eight primary mesenteries corresponding to the *Edwardsia* mesenteries, are perfect, gonophoric, and provided with mesenterial filaments.

2. Oractis Diomedeæ, sp. nov.

Plate XIX, Figs. 5–8; Plate XX, Figs. 9–11.

No. 727. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Several specimens.

All the specimens are contracted extensively (Pl. XIX, Figs. 5 and 6), and measure in this condition 5 to 8^{mm} in height and 10 to 13^{mm} in diameter. The base and column are colorless and translucent, allowing the internal organs to show through, but sections show that the disc and tentacles have yellow pigment granules in their ectoderm, and probably in the living condition they had a more or less decided yellow color.

The base is more or less rounded (Pl. XIX, Fig. 5) and passes directly into the column, there being no limbus. The column is marked by twenty longitudinal grooves corresponding to the insertions of the mesenteries. At the summit of the contracted animal ten tubercle-like processes can be seen surrounding the entrance into the cavity containing the contracted tentacles, and in sections these tubercles may be seen (Pl. XX, Fig. 11, *tu*) to be due to thickenings of the mesoglœa. In some of the specimens they appear to be infolded along with the tentacles. The ectoderm of the column wall has entirely disappeared. The mesoglœa is thin, and more or less fibrillar in structure with comparatively few cells. The sphincter muscle is of the diffuse type (Pl. XX, Fig. 11.), its mesoglœal processes being long and numerous, so that a fairly strong muscle is produced.

The tentacles appear to be ten in number. They are rather short, cylindrical, obtuse. In transverse sections it is seen that their longitudinal muscles are confined to the ectoderm, and for the most part are

of moderate strength, but towards the base two regions are to be found upon the outer surface of the tentacle where the muscle processes reach an excessive development (Pl. XIX, Fig. 7.) In sections which pass through the point of origin of the tentacles, just where they arise from the disc (Pl. XX, Fig. 10), it can be seen that these two muscle bundles (*m*) are continued upon the disc, forming strong muscles lying immediately over the mesenteries, one bundle of each tentacle coming from the mesoglœa over each of the mesenteries which limit the intramesenterial space to which the tentacle belongs. These muscle bundles are not, however, continued to any extent upon the disc towards the mouth opening, but appear to be confined to the peripheral region where the tentacles arise.

The stomatodæum (Pl. XIX, Fig. 8*t*) is rather short, and has only one siphonoglyphe which is deep, its mesoglœa being much thicker than it is elsewhere on the stomatodeum. The remainder of that structure is marked by six longitudinal ridges, each of which corresponds to the insertion of a mesentery.

As is indicated by the furrows of the exterior of the column there are twenty mesenteries. Eight of them are perfect, gonophoric, and provided with mesenterial filaments, while the remaining twelve are imperfect, sterile, and destitute of filaments. The arrangement of the mesenteries is exceedingly interesting (Pl. XIX, Fig. 8). There are two pairs of directives, having the characteristic arrangement of the longitudinal muscles; that pair (III) which is attached to the siphonoglyphe marks the sulcar surface of the body. On each side of the sulcar directives is an imperfect mesentery (V) with its longitudinal muscle upon its sulcular surface, and succeeding this comes a perfect mesentery (I) forming with the imperfect one a pair. Then follow a pair of imperfect mesenteries (VIII), then a pair formed by a sulcar imperfect (VI) and a sulcular perfect mesentery (II), then a pair of imperfect mesenteries (VII), and finally the sulcular directives.

It must be stated that the figure I have given is to a certain extent diagrammatic, inasmuch as in a section through the stomatodæum the longitudinal muscles of the imperfect mesenteries could not be readily made out, while further up the column, in sections which passed through the column and disc, they were well developed. I have represented therefore the arrangement as regards the perfectness or imperfectness of the mesenteries as seen in a section passing through the stomatodæum, but the musculature as seen in sections passing through the column and disc.

The longitudinal muscles are not strong, and in the perfect mesenteries occupy the greater part of the surface (Pl. XX, Fig. 9). The endoderm of the mesenteries presents a rather peculiar vacuolated appearance, reminding one of the structure which it presents in *Cerianthus*. The mesenterial filaments which are developed only on the eight perfect mesenteries appear to lack the "Flimmerstreifen" but I can not be

certain that they are really absent. The contraction of the specimens renders it difficult to understand the exact structure of the filaments. The ova are large and contain a considerable amount of food-yolk.

The significance of the arrangement of the mesenteries of this form I have elsewhere pointed out ('91). The eight perfect mesenteries evidently correspond to the eight *Edwardsia* mesenteries; the imperfect mesenteries which form pairs with adjacent perfect ones (I and II), are evidently the mesenteries which convert the octameral into the dodecameral condition with paired mesenteries. The imperfect pairs VII and VIII are secondary mesenteries and arise in pairs in the two intermesenterial chambers nearest the sulcular directives.

If we omit pair VIII we have the arrangement which occurs in *Gonactinia* (Blochmann and Hilger, '88), and if the sulcular member of pair VII be omitted the condition obtaining in *Scytophorus* (Hertwig, '82) will appear. It seems that these two forms, together with *Oractis*, represent three links in the chain by which the ancestor with twelve mesenteries, all of which arose singly and bilaterally, becomes converted into the Hexactiniæ, in which the muscles arise in pairs and radially. In *Scytophorus* the original method of formation is carried over into the formation of the single secondary mesentery. In *Gonactinia* the paired mode of formation is beginning, in *Oractis* it is thoroughly established, but in both these forms the bilateral mode still holds. Finally, in *Halcampa* the mesenteries arise in pairs and radially.

It will not be necessary to enter into the details of this idea here, since it has been treated of elsewhere in connection with some other facts ('91*a*). It may be well, however, to point out that there is embryological evidence to show that the secondary mesenteries of the Hexactiniæ make their appearance in the sulculo-lateral chambers earlier than in the others, and those of the lateral chambers develop before those of the sulco-lateral ones (Dixon, '89), a succession which exactly corresponds with the phylogenetic development seen in the Protactiniæ.

Tribe HEXACTINIÆ.

Actinozoa with six, eight, or ten pairs of perfect mesenteries, which form a principal cycle, and to which may be added a varying number of additional cycles, perfect or imperfect, the mesenteries of which develop in pairs and radially, appearing almost simultaneously in all the intermesenterial spaces. The longitudinal muscles of each pair are on the faces which look towards the intramesenterial spaces, except in the case of two (occasionally one) pairs, the directives, which are attached to the two (occasionally one) siphonoglyphes, and whose longitudinal muscles are on the faces which are turned towards the adjacent intermesenterial spaces.

The above definition differs considerably from that given by Hertwig ('82), who founded the tribe. This results from the fact that I include

within it not only hexamerous forms, but also octamerous and decamerous Actinians. In other words, I fuse with the original Hexactiniæ Hertwig's tribe Paractiniæ, which is altogether artificial and unnecessary. My reasons for this opinion have been given at length elsewhere and need not be repeated ('89, '91).

Order ACTININÆ, Andres.

Hexactiniæ in which the tentacles are arranged in cycles, only a single tentacle communicating with each endocœl.

Family HALCAMPIDÆ.

Actininæ with a small number of mesenteries, six, ten, or twelve pairs being all that are present; longitudinal muscle pennons narrow, but strong; no special sphincter muscle; conchula present or absent; base usually rounded and vesicular.

In his monograph, Andres ('83) divided the family Ilyanthidæ, which had been previously limited by the exclusion of the Ceriantheæ and Edwardsiæ, into three distinct families, or, as he termed them, subfamilies. One of these, the Halcampidæ, contained the genus *Halcampa*, the Ilyanthidæ included only the genus *Ilyanthus*, while for those forms which possessed a conchula the family Siphonactinidæ was established.

A more recent author, Haddon ('89), seems to regard this last family with uncertainty. At all events he removes from it and associates with the Halcampidæ the genus *Peachia*, recognizing, however, the the possible necessity for the establishment of a separate family for it.

The uncertainties which interfere with the delimitation of the family Halcampidæ are mainly two. Are forms which possess a conchula to be associated with others which do not have this structure, but whose mesenterial arrangement is similar? And are decamerous to be associated with hexamerous forms? I believe that both these questions should be answered affirmatively. The forms belonging to the family Siphonactinidæ, so far as they are known, agree in certain important features, viz, in the usual absence of an adherent base, the absence of a sphincter, the small number of mesenteries, and the strong though narrow longitudinal muscles, with the members of the genus *Halcampa*, and differ from them only in the possession of a conchula, a structure of probably comparatively little morphological importance. As regards the arrangement of the mesenteries, even if we separate the forms with a conchula from those without it, it will be necessary to associate together hexamerous and decamerous species, unless we wish to multiply families beyond convenience and necessity. *Halcampa endromitata*, etc., are hexamerous, and *H. producta* is decamerous among the Halcampidæ; and among conchula-bearing forms *Peachia hastata* is decamerous, while *Bicidium parasiticum* is hexamerous, possessing twelve pairs of mesenteries.

I think that the purposes of classification will be better served by uniting these and similar forms into a single family, for which the name Halcampidæ, already used in this sense by Haddon ('89), may be employed, and to recognize in this family several genera. The genus *Halcampa* seems to be well characterized by its hexamerism and the distinction into capitulum, scapus, and physa. *H. producta*, of the east coast of North America, and *H. capensis* Verr., *H. brevicornis* (Stimpson), and *H. Stimpsonii* Verrill ('65), decamerous forms, may be referred to another genus, though probably it will be well to separate *H. producta* from the other three and refer it to a separate genus. The form described by Jourdan ('80) as *Ilyanthus Mazeli* seems to be closely related, and *H. producta* may be referred with it to the genus *Eloactis* proposed by Andres ('83).

In addition to these three genera, since Andres' genus *Halcampella* and Danielssen's *Halcampoides* ('90) do not seem necessary, there will be of the conchula-bearing forms *Peachia*, which is decamerous, and *Bicidium*, which is hexamerous. The genus *Actinopsis*, which is associated with these two genera by Andres, presents certain external characters which make one hesitate somewhat to retain it in the group. Until an anatomical study of it has been made it will probably be as well to leave it where it is.

Among the *Albatross* material I find two species which may be referred to the family thus emended. One of these is a *Peachia;* the other must, I think, be referred to a new genus related to *Halcampa* or *Eloactis*.

Genus **HALCURIAS**, gen. nov.

Halcampidæ with an adherent base; column cylindrical; tentacles numerous and short; ten pairs of mesenteries, all of which are perfect, though four pairs situated in the sulco-lateral and lateral intermesenterial spaces are less extensively developed than the other six. No conchula.

3. **Halcurias pilatus**, sp. nov.

Plate XX, Figs. 12–13. Plate XXI, Figs. 14–15.

Nos. 708, 709. Station, 2785. Lat., 48° 09′ S.; long., 74° 36′ W. Depth, 449 fathoms. Three specimens.

The base is flat and adherent, one of the specimens being seated upon a piece of dead coral. The column (Pl. XX, Fig. 12) is cylindrical, much wrinkled from contraction, but apparently possessing no warts or tubercles. It measures 2.3^{cm} in height, while its diameter at the base is 2^{cm}. Slight indications of longitudinal bands of color can be perceived, but they are exceedingly obscure and could not be discovered on all the specimens.

The margin is smooth and forms a very distinct parapet around the bases of the tentacles. These are numerous, amounting to about seventy in one specimen in which they were counted, and are arranged

in about three cycles. They are simple, cylindrical and taper to a point; and cover almost the entire disk. There being no special sphincter muscle, the tentacles are not covered in contraction.

There is no conchula, and only one siphonoglyphe, which is neither very deep nor well defined. The surface of the stomatodæum possesses numerous ridges, which are high (Pl. XXI, Fig. 14, *st.*) and may bifurcate at the extremity or give off secondary ridges. They are more numerous than the mesenteries, and do not seem to stand in any very definite relation to them. The mesenteries are twenty in number. They are arranged in pairs, two of the pairs being directives, and are all perfect. Below, however, it is seen that four of the pairs, as in *Peachia*, are much narrower than the other six, these narrow pairs being situated in the sulco-lateral and lateral intermesenterial spaces. The mesenteries are thin; at the base there are pinnately arranged muscle processes (Pl. XX, Fig. 13, *bm.*), and separated from these by a region in which the mesentery is exceedingly thin are the longitudinal muscles. These are very strong (Pl. XX, Fig. 13), but at the same time narrow, forming a strong protuberance upon the surface of the mesentery. Above, however, they widen out (Pl. XXI, Fig. 14) and the processes are not so high.

All the mesenteries bear reproductive organs.

There are a few points in the histology of this species which are interesting. The mesoglœa is fibrillar, especially towards its inner surface, and contains very numerous cells. It is in the ectoderm however, that the most interesting peculiarities appear. The ectoderm of the column wall is high and contains, as usual, many gland cells. In addition to the usual elements, however, it also contains numerous nematocysts (Pl. XXI, Fig. 15, *n*) lying in its outer portion, sometimes very closely crowded together. Immediately external to and resting upon the mesoglœa, roundish bodies—or, rather, bodies appearing round in cross-section (*mf.*)—which stain somewhat deeply, can be perceived. These seem to be muscle fibres, having a longitudinal direction. They have all the appearance of muscle fibres, but I was not able to render their nature certain by the study of maceration preparations. Futher evidence for their muscular nature is, however, to be found in the presence, exterior to them, of a thin layer of fibrillæ having all the appearance of a nerve layer.

Longitudinal muscles and a nerve layer are, as a rule, absent in the column wall of the Hexactiniæ; but, on the other hand, are well developed in the Ceriantheæ, and it seems probable that the more primitive Actinozoa likewise possessed them. Hitherto they have been found among the Hexactiniæ only in *Corynactis?* sp? and *Corallimorphus obtectus*, in which forms they have been described by Hertwig ('88). The fibres of *Halcurias* resemble those of *Corallimorphus* in being poorly developed, and are apparently fewer in number. In *Corynactis?* on the other hand, they seem to reach a fair degree of development,

A few words are necessary regarding the affinities of this form. It differs from all other genera of the Halcampidæ by its adherent base and by the large number of tentacles which it possesses. *Actinopsis* possesses the same characteristics, although the tentacles are much longer in proportion, but differs in having a conchula. There is reason to doubt, however, whether *Actinopsis* can be referred to this family. Among the members of the family, however, indications of an adherent base are found, as in *Eloactis producta*, and the importance of this character seems to be far outweighed by the small number of the mesenteries and the structure of their muscles. It seems tolerably certain that the Halcampids are the simplest and probably the most primitive of the Hexactiniæ, and the presence of longitudinal muscle fibers in the ectoderm of the column wall of *Halcurias* is a primitive characteristic. I think, on the whole, that it is to be regarded as much more nearly related to the Halcampids than to any other family of Hexactiniæ.

Genus **PEACHIA**, Gosse.

Halcampidæ, with rather short tentacles, few in number; with four pairs of narrow sterile mesenteries, situated in the lateral and sulcolateral intermesenterial spaces, and six pairs of perfect fertile mesenteries; and with a single deep siphonoglyphe. Longitudinal muscles of the mesenteries strong. Conchula present.

Gosse ('55) instituted this genus for the reception of *P. hastata* and *Halcampa chrysanthellum*, later on, however ('58), removing the latter form to the genus to which it is now universally assigned. Andres ('83) employs, instead of Gosse's name, that proposed by Koren and Danielssen ('56), *Siphonactinia*, but the term proposed by Gosse has undoubtedly the priority, as Haddon points out ('84). In his revision of the British Actiniæ, Haddon ('89) gives a definition of the genus somewhat more precise than that given above, including certain peculiarities which seem likely to prove specific rather than generic. If they are retained the form described below and *Siphonactinia Boeckii* would be excluded from the genus, to which they seem naturally referable. Rather than establish a new genus for their reception, I prefer to extend somewhat the limitations of the genus *Peachia*.

4. **Peachia koreni**, sp. nov.

Pl. XXI, Fig. 16.

No. 954. Station, 2764. Lat., 36° 42′ S., long., 56° 23′ W. Depth, 11¼ fathoms. One specimen.

The single specimen of this species (Pl. XXI, Fig. 16), which I dedicate to Prof. Koren, to whom, in collaboration with Prof. Danielssen, we owe the Fauna Litoralis Norvegiæ, is evidently closely related to *P.* (*Siphonactinia*) *Boeckii* (Kor. et Dan.). I regret that I can not give as complete a description of it as I should like to do, owing to a disinclination to mutilate the sole example obtained.

The base does not seem to have been adherent, but it is somewhat mutilated, so that it is not possible to be certain of this. No distinction, however, into capitulum, scapus, and physa is possible. The column is considerably wrinkled by contraction and shows no trace of tubercles or warts, and is not covered with foreign substances. Toward its lower part longitudinal grooves, marking the insertions of the mesenteries, are to be seen, but they can not be traced upward toward the margin for any distance. The height of the column is 1.1^{cm} and its diameter 0.8^{cm}.

The margin is simple, and in the contracted specimen covers the bases of the tentacles. These are only eight in number and are short and stout.

The conchula, formed by the prolongation of the lips of the single siphonoglyphe, is as long as the tentacles. On each side of the main portion of the conchula is a lobe rising only to about half the height of the former, and at the sulcular extremity of the mouth is a still smaller unpaired lobe.

By cutting across the column until it was almost divided I was able to ascertain the arrangement and number of the mesenteries without appreciably mutilating the specimen. There is only one siphonoglyphe, which is long and deep, with thick and firm walls, almost cartilaginous in their consistency. The mesenteries are twenty in number, arranged in ten pairs; two of these are directives, and in addition to these there are four other perfect pairs of about equal width, making altogether a principal cycle of six pairs of mesenteries. The remaining four pairs are imperfect and much narrower, and are situated in the sulco-lateral and lateral intermesenterial spaces. The longitudinal muscles are strong.

The arrangement of the mesenteries is the same as that found in *Peachia hastata*, but, as already stated, the general appearance of the animal, the form of its tentacles, and the possession of a well-developed conchula bring it very close to *P.* (*Siphonactinia*) *Bœckii*. Whether the latter has also ten pairs of mesenteries remains to be seen. It has twelve tentacles, which would lead one to suppose that it was hexamerous, but the species here described shows, as does also *Peachia hastata* with twelve tentacles, how little can be ascertained as to the number of the mesenteries from the number of the tentacles. It is possible that the specimen of *P. Koreni* examined was young and had not developed its full quota of tentacles. I can not make any statements with regard to the presence or absence of reproductive elements, not having made microscopical preparations of the mesenteries.

I think, however, that there can be no doubt as to the specific distinctness of this species from that obtained on the Norwegian coast. The form of the conchula is entirely different, a fact in itself sufficient, in the present state of our knowledge of the anatomy of the conchula bearing Halcampidæ, to warrant the establishment of a distinct species.

Family ANTHEADÆ.

The limitations of this family proposed by R. Hertwig ('82) seem satisfactory and will be adopted here.

Genus ACTINIA, Linn.

It seems doubtful whether such definitions as Andres ('83) proposes can be maintained for the genera *Actinia* and *Anemonia*. It may be, perhaps, better to unite all the forms of these genera which possess acrorhagi under the genus *Actinia*, leaving those destitute of such structures and without a distinct collar and fosse in the genus *Anemonia*.

5. Actinia infecunda, nom. nov.

Plate XXI, Fig. 17.

Synonym: *Comactis flagellifera*, Hert. (non-Dana).
Nos. 957, 1739, Abrolhos Islands. Two specimens.

The resemblance of these forms to that described by Hertwig as *Comactis flagellifera* is very great, and it seems almost certain that they are identical with it. They are somewhat smaller, measuring 0.25^{cm} in height, with a diameter at the base of 0.5^{cm}, and at the margin of 0.7^{cm}. The sphincter muscle differs from the figure given by Hertwig ('82) only in being a little broader, and the radial muscles of the disk have the Cerianthan appearance which Hertwig mentions. The siphonoglyphes are not well defined though easily made out in sections, and have as usual directive mesenteries connected with them.

All the mesenteries appear to be perfect, though the youngest cycle are clearly marked out in sections below the middle of the stomatodæum by being much narrower than the mesenteries of the other cycles, all of which are about the same width, so that a pair of broad mesenteries alternates regularly with a narrow pair. I found indications of reproductive organs, but the ova were few in number, though fairly large, and appeared to occur in a few of the larger perfect mesenteries. Hertwig did not succeed in finding reproductive elements in the specimen he examined, and considered it therefore to be immature. Since, however, the specimens which I have studied possess ova and yet are smaller than Hertwig's specimen it seems probable that the latter is to be considered mature.

One interesting histological peculiarity I have observed in this form may be mentioned. It is in connection with the structure of the upper part of the mesenterial filaments. The mesoglœa has as a rule only a few scattered cells, but in the processes which support the median and lateral portions of the filament in its upper part the cells become exceedingly numerous, closely packed together in the thickened mesoglœa.

(Pl. XXI, Fig. 17, *mg*). I have not met with such an arrangement in any other forms, and it forms a very striking peculiarity.

As already stated there seems little room for doubt but that this species is the same as that described by Hertwig as *Comactis flagellifera*. The external appearance is the same and the anatomical peculiarities are so similar that I do not believe a separation of them would be justifiable. Nevertheless, I have not followed Hertwig in his identification of the form. It was with some hesitation that he associated his form with Dana's *Actinia flagellifera*, recognizing the great difference between his specimen and the figure given by Dana ('46). He regarded Verrill's account ('66) of the alcoholic specimens as furnishing a reconciliation of the discrepancies, notwithstanding the paucity of the facts which Verrill contributed. Johnson ('61) has, however, studied the sea anemones of the region where Dana's form was collected, namely, Madeira, and convinced himself that it was in reality identical with the common European *Anemonia sulcata*, which view is accepted by Andres. For this reason it seems advisable to separate Hertwig's *Comactis* under a new name.

Genus **ANEMONIA**, Risso.

6. **Anemonia variabilis**, sp. nov.

(See Appendix P.)

Plate XXI, Figs. 18, 19.

Nos. 694, 1362. Station, 2768. Lat., 42° 24′ S.; long., 61° 38′ 30″ W. Depth, 43 fathoms. Numerous specimens.

The numerous specimens (Pl. XXI, Fig. 18) were for the most part only partially contracted, and measured in this condition 0.5 to 0.7^{cm} in height and 0.5 to 1^{cm} in diameter at the base. They were seated upon sponges or occasionally upon Tubularian stems, the base of the Actinians in the latter cases surrounding the stem.

The column is somewhat wider at the base than higher up and has therefore a slightly conical shape. The ectoderm for the most part has been macerated away, leaving the slightly translucent mesoglœa exposed, and allowing the insertions of the mesenteries to be seen through the wall as fine longitudinal striæ. The mesoglœa is comparatively thin and almost perfectly homogeneous, containing very few mesoglœal cells. No verrucæ or acrorhagi are present.

The tentacles are short and numerous, usually approaching one hundred, but varying in number in the various specimens. One tentacle communicates with each exo—and each endocœl, and their number depends upon the number of mesenteries present in any one individual. In the majority of cases they are completely exposed, the sphincter muscle of the column being endodermal and diffuse and very weakly developed, as is the case with the general musculature throughout the body. The

ectodermal muscles of the tentacles and disk form a simple layer, the mesoglœa not being raised into supporting processes.

The stomatodæum is elongated, but without well-marked siphonoglyphes. Its ectodermal lining is thrown into very pronounced folds, supported by delicate though high longitudinal ridges of mesoglœa (Pl. XXI, Fig. 19).

The mesenteries are irregular in number. In sections of three specimens, for example, there were respectively 28, 33, and 36 pairs. As a rule a perfect and an imperfect pair alternate, but this arrangement is not infrequently interrupted by the succession of two pairs of perfect ones, or of three or two pairs of imperfect ones. There are two pairs of directive mesenteries, and the number of mesenteries intervening between them on each side is usually the same, though there are exceptions to this rule. In the specimen of which a section is figured on Pl. XXI, Fig. 19, it will be seen that only eleven pairs of mesenteries intervene between the two directives (*D*) on one side, while there are as many as twenty-one on the other side. This section represents the condition as seen towards the level of the lower extremity of the stomatodæum. Higher up two pairs of mesenteries are to be found which are not represented at the level figured, and these increase the number of mesenterial pairs of one side of the body to fourteen—*i. e.*, thirteen pairs intervene between the two directives. Even in the uppermost sections, however, there is not equality in the number of the mesenteries of either side. That the irregularity which is found in the succession of perfect and imperfect mesenteries is not an artificial production is shown by the relation of the perfect pairs on either side of the two (*x*) and three (*y*) imperfect pairs of the figure. It is there seen that these perfect pairs are attached to the stomatodæum opposite successive mesoglœal ridges, and this relation of the ridges to the insertion of mesenteries, though not constant, is of sufficient frequence to warrant the assumption that the groups of mesenteries *x*, *y* are truly imperfect.

The mesoglœa of the mesenteries is considerably thicker a short distance from their insertion into the column wall than elsewhere and is raised into only very low muscle processes. Consequently the muscle pennons are almost wanting, the longitudinal muscles forming little more than a simple layer over the surface of the mesoglœa. None of the specimens examined were mature; immature ova were observed, however, in the endoderm of some of the perfect mesenteries and in that of the directives.

The habits of this form suggested identity with that described by Verrill ('83) as *Sagartia spongicola*. Examination of specimens of the latter showed at once that the two forms were very different, *S. spongicola*, for example, possessing strong muscle pennons on the mesenteries attached by a slight pedicle in a manner recalling the conditions described by Hertwig ('82) for *Leiotealia nymphæa.*

7. Anemonia (?) inequalis sp. nov.

Plate XXXIV, Figs. 114–115.

No. 742. Pichilingue Bay, Lower California. Littoral. Two specimens.

The two specimens which represent this species are contracted, though the tentacles are not completely concealed. The base was adherent. In height the largest specimen measures 0.7^{cm}, with a diameter of 1.3^{cm}. The column wall is thin and soft to the touch, and shows 72 longitudinal lines which mark the insertion of the mesenteries. The ectoderm is completely macerated away. The mesoglœa is fairly thick and is homogeneous in appearance, with numerous cells scattered through the matrix. A sphincter is present; it is endodermal and of the "diffuse" variety, forming, however, a not very compact mass and being rather weak. (Pl. XXXIV, Fig. 114.)

The tentacles are short, and apparently thirty-six in number, arranged in a single cycle. Their ectodermal muscles are weak and are not embedded in the mesoglœa.

The stomatodæum is ridged longitudinally and possesses at least one shallow siphonoglyphe. In half the circumference of one specimen examined eighteen pairs of mesenteries were present, from which it may be concluded that there are altogether thirty-six pairs, a number which corresponds with the number of longitudinal lines seen from the outside. Their arrangement is very peculiar. All are perfect above, but below they are evidently divided into three cycles, each consisting of twelve pairs. If the first cycle be considered to represent two primitive cycles, the apparent second cycle will really represent the third cycle, while the apparent third will be the fourth, in which, however, only half the proper number of pairs has developed (Pl. XXXIV, Fig. 115.). The mesoglœa of the mesenteries resembles that of the column wall, being homogeneous and tolerably thick. The longitudinal muscles are not very strong and cannot be said to form a circumscribed pennon. The parieto-basilars form folds upon the surface of the mesenteries, the edge of the fold sometimes, however, uniting with the mesentery and so producing one or more cavities enclosed within the mesoglœa of the mesentery near the insertion into the column wall. No ripe reproductive elements were present, but I succeeded in finding a few very young mother cells, the macerated condition of the internal parts preventing, however, an accurate determination of their distribution. Some certainly occurred on one of the mesenteries of the second actual cycle and I thought I could distinguish others on some mesenteries of the third and fourth cycles, but of this I can not be certain.

I assign this form provisionally to the genus *Anemonia*. It differs materially, however, from the typical forms of the group, as, for instance, in the short and not numerous tentacles. The abnormal arrangement

of the mesenteries is not, I believe, of sufficient importance to be generic and in the general structure there are undoubted affinities to the Antheadæ. As to the presence of acrorhagi nothing can be said, on account of the absence of the ectoderm, and the macerated condition of the internal parts proved a decided obstacle to a thorough study of the specimens.

Genus CONDYLACTIS, Duch. et Mich.

The genus *Condylactis* was established in 1866 by Duchassaing and Michelotti ('66) for the reception of the common West Indian form *C. passiflora*. I have shown elsewhere ('89) that this form is in all respects an Anthead, and that it agrees closely in general characteristics with the form described by Della Chiaje as *Actinia aurantiaca*, subsequently assigned by Andres ('83) to the genus *Cereactis*, which is referred to a special family. The generic name proposed by Duchassaing and Michelotti has undoubted priority and must replace that proposed by Andres. I see no good reason for separating *Condylactis* from the other Antheads, from which it is distinguished by the absence of acrorhagi and by the presence of a fosse between the margin and the bases of the tentacles, as well as by the usual presence of minute verrucæ upon the column wall.

8. Condylactis cruentata (Dana).

Plate XXI, Figs. 20—21.

Synonyms: *Actinia cruentata*, Dana (1846); *Cereus cruentatus*, Milne-Edwards (1857) *Bunodes cruentata*, Gosse (1860).

No. 736. Sandy Point, Straits of Magellan. Littoral. Four specimens.

All the specimens (Pl. XXI, Fig. 20) are contracted, the tentacles being concealed; in this condition the height and diameter of the column are about the same .05 cm. The preserved specimens show no coloration, but in sections brown granules of pigment are found in the endoderm of the disk and tentacles.

The base is adherent. The column wall is thrown into strong folds, and toward its upper part are rows of verrucæ to which particles of sand are strongly adherent. The verrucæ cease at the well-marked margin, between which and the bases of the external tentacles there is a well-marked fosse, which is made especially evident in contracted specimens by being drawn down by the strong longitudinal muscles of the mesenteries. Circular muscles are developed upon the column wall but are wanting at the margin; internally to this, however, a few small muscle processes are found which represent the sphincter. It is very weak and can have only little effect in producing the concealment of the tentacles; this is mainly brought about by the longitudinal muscles of the mesenteries.

The tentacles are not very numerous; their longitudinal muscles, like the radiating muscles of the disc, are not imbedded in the mesoglœa.

The stomatodæum possesses well-developed siphonoglyphes with smooth walls, the rest of the stomatodæum being longitudinally ridged. There are only sixteen pairs of mesenteries, all of which are perfect, eight losing connection with the stomatodæum, however, sooner than the others. The longitudinal muscles are strongly developed, forming a strong pennon (Pl. XXI, Fig. 21), and the parieto-basilar (*pbm*) forms a strong fold upon the surface of the mesenteries. The reproductive organs are borne by the mesenteries of the first cycle, with the exception of the directives. No acontia are present.

There is necessarily some doubt as to the correctness of this identification. The external structure agrees well with Dana's species, as does also the habitat; as to the coloration nothing can be said. In referring it to the genus *Condylactis*, I have separated it widely from the genera to which it has previously been assigned. The nature of the sphincter and the arrangement of the mesenteries indicate a relationship to the Antheadæ, and of existing genera of this family, by its possession of verrucæ, and of a fosse, and by the absence of acrorhagi, it comes nearest to *Condylactis*. It differs from the described forms of this genus in its size and in the prominence of the verrucæ, but it seems advisable for the present to include it in the genus.

9. **Myonanthus ambiguus**, gen. et sp. nov.

Plate XXI, Fig. 22; Plate XXII, Fig. 23.

No. 731*a*. Station 2839. Lat., 33° 08′ N.; long., 80° 15′ W. Depth, 414 fathoms. Many specimens.

In looking over the collection soon after it reached me I noticed that in the bottle which contained the species described below as *Paractis vinosa*, there were a large number of examples of a form which, while resembling the specimens of *P. vinosa* in general form and size, yet differed decidedly in color. On submitting them to anatomical examination I found that very decided structural differences existed, and that I had to do not only with a distinct species, but even with a member of a distinct family. After much uncertainty as to the family to which it should be assigned, I determined to insert it in this report as an appendix to the Antheadæ. My reasons for so doing will better be understood after a description of the specimens has been given.

They are all more or less contracted, some having the tentacles completely contracted, while in others they remain more or less exposed (Pl. XXI, Fig. 22). The color of the column and tentacles is pale pink or flesh color. In height the less contracted specimens measure about 1^{cm}, their diameter ranging from 1.3 to 1.5^{cm}.

The base is adherent, and in many specimens is more or less covered by a dark brown, somewhat granular cuticle. Its diameter is as a rule somewhat greater than that of the column; in the specimen from which the measurements given above were taken its diameter was about

2^{cm}. Its mesoglœa is rather thin, allowing the straw-yellow color of the reproductive organs to shimmer through.

The column wall is smooth for the most part, except for the slight folds caused by contraction. In the more intensely contracted specimens in the upper part twenty-four longitudinal folds were more or less distinct, terminating abruptly at the margin; twelve of the folds are smaller than, and alternate with, the other twelve. The ectoderm has been to a large extent macerated away from the column wall, but where present it has the same color as the mesoglœa. No trace of verrucæ or tubercles could be discovered. The mesoglœa is much thicker than that of the base and has a fibrous structure. It is not, however, stiff and parchment-like to the touch, but on the other hand rather soft and tough. Just at the margin, where the longitudinal folds of the contracted specimens terminate, is a well-developed endodermal sphincter (Pl. XXII, Fig. 23). It can hardly be classed either as "circumscribed" or "diffuse," since, though well defined, it is not connected to the column wall by a distinct pedicle. It is rather intermediate between these two varieties of sphincter, and resembles closely that form of muscle which I have elsewhere ('89 *a*) described for a species of *Phyllactis*. I would suggest the application of the term "aggregated" for this variety of muscle. Its appearance in cross section may be understood by a reference to Pl. XXII, Fig. 23. It is to be observed that anastomes between the muscle processes are not unfrequent, so that bundles of muscle fibers become enclosed within the mesoglœa. Immediately adjacent to the sphincter the ordinary circular muscles of the column are hardly developed, but lower down they become stronger, without, however, forming a second sphincter.

The sphincter seems to occur just at the margin, and apparently a slight fosse exists between this and the outermost tentacles. No acrorhagi could be detected. The tentacles are numerous and arranged in several cycles, but I could not ascertain their actual number. Their color is the same as that of the column and they are of fair length and rather slender. Their longitudinal musculature is not imbedded in the mesoglœa, resembling in this respect the radial muscles of the disc.

The stomatodæum possesses two siphonoglyphes whose lower ends are prolonged apparently some distance beyond the lower opening of the stomatodæum. In consequence of this the directive mesenteries are attached to the stomatodæum throughout a greater extent of their length than are the other perfect mesenteries. There are, altogether, four cycles of mesenteries, of which only the six pairs forming the primary cycle are perfect. The mesenteries of the fourth cycle are small, and hardly project beyond the endoderm. All the mesenteries except those of the fourth cycle and the directives are gonophoric. The reproductive organs are very evident in dissected specimens, owing to their bright orange color due to the presence of numerous oil globules in the ova and sperm mother cells. The mesenterial filaments are not deeply colored, as in *P. vinosa*. This forms a simple point of distinction be-

tween the two associated species. The longitudinal muscles are only moderately developed, and do not form a well-marked pennon. The parieto-basilar seems to be weak. No acontia occur.

From the above description it may be seen that this form is not readily referable to any of the recognized families. On the whole, however, it seems to approach more nearly the Antheadæ than any of the others. The smooth column wall and the distribution of the reproductive elements are points of similarity, but on the other hand the small number of perfect mesenteries and the strong sphincter are decided differences. The sphincter, however, is practically an endodermal one, and the definition given by Hertwig ('82) for the Antheadæ does not exclude the existence of a recognizable sphincter. In fact, in *Actinia infecunda*, which he recognizes as an Anthead, a sphincter is present of such a form that an excessive amount of differentiation would not be called into play to transform it into such a muscle as we find in *Myonanthus*.

I think, accordingly, that it is advisable to refer this form to the family Antheadæ, regarding it as a somewhat aberrant form, which has the power of completely retracting the tentacles, owing to the possession of a well-defined sphincter, a character which has suggested the generic name I have applied to it (μυών = a knot of muscles).

Family BOLOCERIDÆ.

Actininæ with usually stout nonretractile tentacles, strongly constricted immediately above their insertion into the disk, and hence readily deciduous. Sphincter muscle endodermal, diffuse, or in some forms approaching the circumscribed type; the tentacles and disk fully exposed in the contracted condition. With more than six pairs of perfect mesenteries.

Bolocera tuediæ discovered, in 1832, by Johnston, and later referred by him ('47) to the genus *Anthea* may be taken as a typical example of this family. Gosse ('60) established for it the genus *Bolocera*, and separating it from the Antheadæ, with which Johnston and Milne-Edwards ('57) associated it, placed it among the Bunodidæ, in which classification he has been followed by Andres ('83). A study of the form occurring in the deep water off the eastern coast of the United States, and which has been identified by Prof. Verrill with *B. tuediæ*, as well as of other species of *Bolocera* from the *Albatross* collection, has demonstrated that, so far as their anatomical peculiarities are concerned, these forms are very different from the Bunodidæ, but stand in relatively close affiliation to the Antheadæ. The nature of the tentacles, however, and other structural characters, seems to be of sufficient importance to warrant the establishment of a distinct family for them.*

*It seems probable that Danielssen's ('90) *Sideractis* is a *Bolocera*, though the existence of an endodermal sphincter would preclude such an identification. It is to be noticed, however, that Danielssen's figure (Pl. VII, fig. 10) hardly bears out his assertion on this point.

Genus BOLOCERA, Gosse.

With the characters of the family.

10. Bolocera occidua, sp. nov.

Plate XXII, Figs. 24–27.

No. 706. Station 2783. Lat. 51° 02′ 30″ S.; long. 74° 08′ 30″ W. Depth, 122 fathoms. Two specimens.

No. 701. Station 2779. Lat. 53° 06′ S.; long. 70° 40′ 30″ W. Depth, 77½ fathoms. Three specimens.

No. 697. Station 2771. Lat. 51° 34′ S.; long. 63° W. Depth, 50½ fathoms. Two specimens (young).

The base is evidently adherent, and is slightly smaller than the column. It is marked with fine radiating ridges, which are continued over the limbus upon the column.

This is nearly cylindrical, expanding slightly above, and in the contracted condition can not be said to possess verrucæ or warts, though the entire surface is marked out into small quadrangular areas by the crossing of vertical and circular furrows, processes of mesoglœa supporting the ectoderm of the elevated areas (Pl. XXII, Fig. 24). In the largest specimens the height and diameter of the column are about 3^{cm}. Near the margin, in most of the specimens, complicated structures could be seen which, on examination, proved to be mesenterial filaments protruding from openings formed by the falling off of the tentacles.

The margin is tentaculate. The tentacles are large and stout, covering the greater portion of the disk. They are arranged in about four cycles, of which the two inner cycles each possess twelve tentacles, the third cycle twenty-four, and the fourth forty-eight. The tentacles retain their cylindrical shape in the preserved specimens and are plainly furrowed (Pl. XXII, Fig. 26). At their insertion into the disc they suddenly diminish in diameter, so that they are attached by a short and narrow pedicle; they are thickest immediately above the pedicle, where the inner tentacles in the largest specimen measured 0.9^{cm} in diameter, and from that taper gradually towards the extremity, which is somewhat obtuse. The length of the tentacles of the innermost cycle in the largest specimen was 5^{cm}.

In consequence of their manner of insertion into the disc the tentacles are readily broken off, leaving a circular opening upon the disc which indicates their former position. The opening, however, is diminished by a circular fold of mesoglœa, covered by endoderm, which encroaches upon it (Pl. XXII, Fig. 27, *tsp*); the free edge of the fold is thrown into numerous muscle processes, and it seems probable that by the approximation of the edges of the fold the opening may be completely closed.*

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*Since this was written Carlgren ('91) has described, in a paper on *B. longicornis*, a similar sphincter fold. He points out, correctly, that the sphincter is thrown off with the tentacle, and it therefore does not serve to close the opening left on the surface of the disk. My description was drawn up from sections through tentacles still adherent, and the conclusion was somewhat hastily reached that the use of the sphincter fold was to occlude the opening.

The circular muscles of the tentacles and disk are ectodermal and comparatively weak.

The lips are prominent, and are marked by delicate and numerous striæ, which are continued down the stomatodæum and apparently correspond approximately to the mesenteries. Two siphonoglyphes are present and are deep, the directive mesenteries being comparatively narrow.

The sphincter muscle (Pl. XXII, Fig. 24, *sph*) is endodermal and diffuse, the endodermal muscle processes of the column being more numerous and somewhat higher just below the margin than elsewhere.

The mesenteries are arranged in three cycles. The first cycle consists of twelve perfect mesenteries, including two directives, the second cycle likewise of twelve mesenteries, which are imperfect, however, and the third cycle of twenty-four mesenteries, which are quite narrow and imperfect. All the mesenteries of the first and second cycles, with the exception of the directives, are gonophoric. The longitudinal muscles of the mesenteries are fairly well developed, the supporting process covering the entire non-gonophoric region of the mesentery and being of almost uniform height throughout. (Pl. XXII, Fig. 25.) There is no special development of the parieto-basilar muscle.

In its general appearance *B. occidua* resembles very closely *B. tuediæ*. I have been able, however, to examine some preserved specimens of the latter obtained from the deeper water off our eastern coast, and can state that there are marked differences in the anatomy of the two species. For instance, *B. tuediæ* has the tentacles arranged in only three cycles, and the parieto-basilar muscles upon the mesenteries show a condition similar to what occurs in *B. pannosa*, to be described below.

It is possible that the form here described may be identical with Studer's ('78) *B. kerguelensis*, which is described as having the tentacles arranged in several cycles. We possess, however, no account of the anatomical peculiarities of this form; and since the general shape of the body differs decidedly from that of *B. occidua*, and there are said to be seven cycles of tentacles in large specimens, I have considered it advisable to separate the two forms. I believe that in a case of doubt it is preferable to consider the newer form a distinct species; the union of forms improperly separated is a much simpler matter than the separation of forms erroneously identified.

A third form, with which *B. occidua* might possibly be identified, is *B. multicornis*, of Verrill ('79). Andres ('83) places this form among the doubtful Bunodidæ, not being able to determine from Verrill's description whether it is truly a *Bolocera* or not. I have been able to examine a specimen of it, however, and can confirm Verrill's assignment of it to that genus. The greater number of its tentacles and their much smaller dimensions show that it is distinct from *B. occidua*.

11. Bolocera pannosa, sp. nov.

Plate XXII, Figs. 28 and 29. Pl. XXIII, Fig. 30.

No. 729. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Eight specimens.

This form, in its preserved condition, presents at the first glance only a remote similarity to other species of *Bolocera*. One misses the robust appearance and the large, stout tentacles, and finds instead a ragged mass. Closer observation reveals, however, many points of similarity to *B. tuediæ*, and it is necessary to consider both as belonging to the same family, and probably also to the same genus.

The base is oval and attached. In average specimens it measured 7^{cm} in length and 2.5^{cm} in breadth. It is thin, especially toward the center, allowing the mesenteries and the dark, wine-colored pigment of the mesenterial filaments to be indistinctly perceived. Toward the periphery radiating and concentric grooves are readily made out, marking off the surface into small quadrangular areas.

The column is low; in none of the specimens does it exceed 0.7^{cm} in height, and it is folded back upon itself, so that the margin and limbus are nearly in contact. Immediately below the region where the bending back occurs is a relatively strong, circumscribed endodermal sphincter, which is, no doubt, the cause of the reversion of the margin. This sphincter (Pl. XXIII, Fig. 30) consists of a main mesoglœal process projecting out almost at a right angle to the column wall and giving rise to numerous secondary processes mainly on its marginal side, other processes arising below it directly from the column wall and grading off into the ordinary circular muscle processes. This sphincter, it will be noticed, is situated low down on the column wall, some distance away from the margin. Muscle processes supporting circular muscles occur above it, but they are not specially aggregated to form a sphincter. The sphincter which is present is to be regarded as a lower sphincter, the marginal sphincter not being developed.

The surface of the column is divided into small quadrangular areas by longitudinal and circular lines corresponding to the radiating and concentric grooves of the base. No warts or verrucæ, however, seem to be present, nor are there any very decided mesoglœal processes supporting the quadrangular areas as in *B. occidua*.

The entire animal is of a pale rosy tint, or in some cases salmon-colored, the mesenterial filaments being of a deep wine purple. Probably in life the colors were more pronounced, resembling the coloration which seems usual to the Boloceridæ.

The margin is tentaculate. The tentacles are numerous and strongly entacmæous, arranged apparently in about seven cycles, 6, 6, 12, 24, 48, 96, 192. The inner tentacles measure about 3.7^{cm} in length, and apparently are not capable of being contracted to any very great extent. In their general structure the tentacles resemble those of *B. tue-*

diæ, being constricted just at their insertion into the disc, being widest just distal to the constriction; consequently they readily fall off, leaving a round opening in the disc. These openings are, however, partially closed by a muscular fold of mesoglœa arising from their margins, and similar to what has been already described for *B. occidua*.* Notwithstanding their close similarity in the structure, the tentacles have a very different appearance from those of the species just mentioned. Instead of being plump, turgid, and robust, they are flaccid, flattened, and rather slender, and give to the preserved specimen a very ragged and torn appearance. It is on this account that I have bestowed upon the species the name *pannosa*.

The musculature of the tentacles is weak, the ectodermal muscles not being imbedded in the mesoglœa (Pl. XXII, Fig. 28), but supported by hardly noticeable mesoglœal elevations. The longitudinal ridges of mesoglœa which give to the tentacles of the Boloceridæ their fluted appearance are readily to be seen in the tentacles of the inner cycles, but they are not so well developed as in other species of Bolocera.

The disc is almost entirely covered by the tentacles, only a relatively small area around the mouth being naked. Its ectodermal muscles are weak, though the endodermal circular system is fairly well developed; less so, however, toward the margin.

The stomatodæum is prominent and possesses two siphonoglyphes. The mesenteries are numerous, there being probably about ninety-six pairs, of which twenty-four are perfect and non-gonophoric (two of them being directives), twenty-four well developed, though not perfect, and forty-eight relatively small. All the imperfect mesenteries are gonophoric. The musculature of the mesenteries is not particularly strong, but presents a very peculiar arrangement. If a transverse section of a mesentery of the first cycle be examined (Pl. XXI, fig. 29) it will be seen that at its attachment to the column wall it is comparatively thin; it soon, however, becomes thicker, and numerous cavities, containing apparently the degenerated remains of cells, are seen in the mesoglœa. The exocœlic face of this portion of the mesentery bears muscle processes which are cut transversely (*pbm*), and therefore give support to longitudinal muscles, or rather to the oblique muscles forming the parieto-basilar muscle. The inner edge of this muscle is to a slight extent free from the mesentery, and it seems as if the cavities had been produced by the fusion at intervals of the mesoglœa of this free edge with that of the mesentery during the growth of the animal. Beyond the region of the parieto-basilar muscle the mesoglœa becomes thinner, and its exocœlic surface is covered by a simple layer of muscle cells whose fibres internal to the parieto-basilar region run longitudinally, then became transverse, and finally near the insertion of the mesentery into the stomatodæum become again longitudinal, being now supported

*See note p. 151.

on short processes of mesoglœa. On the endocœlic face of the mesentery near its insertion into the column wall are muscle processes bearing longitudinal muscles (*lm*), but the greater portion of the surface is covered by a well-marked layer of transverse muscles (*tm*), amongst which, however, some longitudinal fibres may be detected. This transverse layer covers about two-thirds of the surface, but the third adjacent to the stomatodæum is occupied by the moderately developed longitudinal muscle-pennon (*lm*). The arrangement appears at first sight to be the normal relations reversed, so far as the faces of the mesentery are concerned, and to a certain extent this is the case. The greater portion of what normally would be exocœlic transverse musculature has become longitudinal, while the endocœlic longitudinal musculature has to a large extent become transverse. The longitudinal muscle-pennon, and the parieto-basilar muscle still, however, retain their normal relations.

A histological point was well shown in the preparations of this form, on account of the specimens having undergone a certain amount of maceration in the preserving alcohol. Delicate mesoglœal filaments can readily be seen to extend from the muscle processes out between the cells, both of the ectoderm and the endoderm. I have called attention to this fact in the case of *Cerianthus americanus* ('90), and have since observed it in numerous forms, so that it is probably a normal arrangement.

12. **Bolocera brevicornis**, sp. nov. (See Appendix, p. 209.)

Pl. XXIII, Figs. 31–33.

No. 730. Station 2839. Lat. 33° 08′ N., long. 118° 40′ W., 414 fathoms. Two specimens.

This interesting form was dredged in the same locality as *B. pannosa*. It is represented in the collection by two specimens, one of which is apparently full grown, while the other is evidently young. The base is circular in outline and adherent. It measures in the large specimen 2^{cm}.

The column wall is bent downwards, so that the margin is almost level with the base, and the whole expanse of the disk is exposed. The column is marked by numerous longitudinal lines, extending from the limbus to the margin, where they terminate in a well-marked circular fold. Apparently the upper portion of the column is furnished with verrucæ, but owing to the somewhat imperfect preservation of the column ectoderm it is impossible to be certain on this point. The mesoglœa of the column is moderately thick, and on its inner surface is richly folded, so that the circular musculature is relatively strong. In the region of the circular fold, which forms the margin, the muscle processes are longer and more closely aggregated than elsewhere, forming a well-marked endodermal sphincter of the diffuse type (Pl. XXIII, Fig. 31). Below the sphincter the wall is thinner than elsewhere, and has the ap-

pearance of being pouched, the pouches perhaps corresponding to verrucæ. Below this thin region the muscle processes are somewhat longer than further down, suggesting a second sphincter.

The disc is very broad, measuring 6^{cm} in diameter. Its whole surface, with the exception of a small area immediately surrounding the mouth, is covered with tentacles, or with openings which correspond to them. The tentacles must have been exceedingly numerous when all were present, having been arranged in as many as fourteen or fifteen cycles. They are short, very short, when compared with those of *B. tuediæ*, those of the inner cycles, a few of which persist in the large specimen, measuring only 1.6^{cm} in length. In other respects, however, they have all the characteristics ot the Bolocerid tentacles. They are attached to the disc by a narrow neck, the mesoglœa of which is very thin. They are readily deciduous and they are fluted. In character they resemble the tentacles of *B. pannosa* rather than *B. tuediæ*, being somewhat flaccid. Above the neck of the tentacle there is a sphincter-bearing fold of mesoglœa, projecting into the cavity of the tentacle, as in other Bolocerids.

The mouth is slightly prominent and two well developed siphonoglyphes are present. It is difficult to estimate the number of mesenteries present. I judge that there are about forty-eight pairs of perfect mesenteries. Between each pair of perfect mesenteries there are three well defined series of mesenteries of gradually diminishing size and belonging to three different cycles, so that if the estimate of forty-eight is correct for the first cycle, there will be in all three hundred and eight-four pairs of mesenteries, arranged in four regular cycles. This number does not, however, at all compare with the number of tentacles, and if the column wall be closely examined a number of minute ridges may be seen between the pairs of mesenteries, hardly, if at all, rising above the level of the endoderm, and not apparently arranged in regular pairs or separable into definite cycles. These seem to be somewhat irregularly formed abortive (or incipient?) mesenteries, an attempt being apparently made to preserve the relation of mesenteries to tentacles which is usually found.

The specimens examined show no trace of reproductive organs, but from the general appearance of the mesenteries it is presumable that the ova or spermatozoa are borne by the imperfect mesenteries of the second, third, and fourth cycles.

The musculature of the mesenteries is weak and presents no such peculiar appearance as has been described for *B. pannosa*. The muscles on the endocœlic face, however, appear to be transverse in the region near the column wall, but form a low and diffuse longitudinal muscle pennon covering the inner three-quarters of the muscle-bearing region of the mesentery (Pl. XXIII, Fig. 33). The parieto-basilar muscle is present (Pl. XXIII, Fig. 32), as shown by the direction of its fibres, but it produces no such cavities in the mesoglœa of the region of mes-

entery occupied by it as it does in *B. pannosa*. The musculature of the rest of the excœlic surface is for the most part oblique, becoming for a short distance transverse, and finally, as in *B. pannosa*, becoming longitudinal. The general arrangement of the musculature therefore agrees closely with that of *B. pannosa*, the main difference being the absence of cavities in the mesoglœa of the parieto-basilar region.

This form is one of considerable interest. When I first saw it in glancing over the collection, I believed I had before me a specimen of Hertwig's *Liponema multiporum* ('88). The presence of the tentacles, however, induced me to believe that I was wrong in this supposition, but the general similarity in appearance suggested the idea that possibly Hertwig's specimens were identical with this, but had lost all their tentacles. When I had finished my study of the anatomy of *B. brevicornis*, I perceived that this idea was not quite correct, but that though the two forms can not be considered identical specifically, yet they are so closely related as to warrant the conclusion that they belonged to the same genus, and that *Liponema multiporum* is a *Bolocera* which has lost all its tentacles.

To anyone who has followed my description carefully and has compared it with that of *Liponema*, I think the similarity between the two forms will be apparent. There is the same general appearance, the same folding back of the voluminous disk, the same "stomidia" almost covering the disk (though in the *Albatross* form these are normally surmounted by tentacles), the same circular fold at the margin, the same longitudinal lines on the column, a similar double endodermal sphincter, the two muscles being separated by pouchings out of the column wall, the same discrepancy between the number of mesenteries and tentacles (or stomidia), and a close similarity in the arrangement of the perfect and imperfect mesenteries.

These similarities are, I think, sufficient to mark the two forms as belonging to the same genus. The different shape of the marginal sphincters and the slight difference in the arrangement of the mesenteries leads to their assignment to distinct species.

It is worthy of note, too, that Hertwig describes a sphincter fold closing the openings on the disk, the "stomidia." This reminds me strongly of the muscular fold in the tentacles described in the preceding species of *Bolocera*. Taking all the facts into consideration, I believe that Hertwig's *Liponema multiporum* should henceforth be known as *Bolocera multipora*.

Family PARACTIDÆ, R. Hert.

Actiniæ usually with numerous perfect mesenteries; circular muscle strong, imbedded in the mesoglœa; acontia wanting.

The family Paractidæ was established by R. Hertwig ('82) on anatomical grounds, the forms belonging to it having been previously associated for the most part with the Antheadæ. In the above defini-

tion I have modified somewhat that given by Hertwig, thereby extending the limits of the family so as to include certain forms with short, stout, non-retractile tentacles. I consider the presence of a strong mesoglœal sphincter and the absence of acontia the two most marked characteristics of the family, the number of mesenteries being of less importance, for although the majority of forms to be assigned to the family possess numerous perfect mesenteries there are nevertheless some in which only the mesenteries of the first cycle are perfect. These are, however, so closely related to those with numerous perfect mesenteries that it seems to me injudicious to separate them.

Andres ('83) independently established a family Paractidæ, which probably is identical with that of Hertwig. The definition was, however, founded altogether on external characters, which are undoubtedly of less value in Actinian taxonomy than are anatomical features.

Genus **PARACTIS**, M.-Edw.

Paractidæ with smooth body-surface, without papillæ or marginal spherules; tentacles, slender, not exceptionally numerous, nearly equal in length and strength; margin not lobed. Sphincter widening somewhat abruptly in its upper part, and occupying near the margin nearly the entire thickness of the mesoglœa. This is the definition which Hertwig ('82) gives of the genus, with the exception that he includes in the definition the presence of "numerous longitudinal furrows of the wall," which it appears to me limits the genus too narrowly, and by what is probably a more or less trivial character. He himself points out the possible alliance of his *P. excavata* to the *Actinia peruviana* of Lesson, in which the longitudinal furrows, are wanting, except near the base, the column wall being described as smooth.

In the *Albatross* collection there are two forms which must be assigned to the genus as here limited, although they differ greatly in certain respects. In one, the column wall, though not particularly thick, is leathery, while in the other it is of a much softer consistency; and again in one the radial muscles of the disc and longitudinal muscles of the tentacles are imbedded in the mesoglœa, while in the other they are ectodermal. Whether this latter feature is one sufficient for generic distinction can only be determined by the examination of a large number of Paractidæ. I propose to place both the forms provisionally in the genus *Paractis*, leaving it for future workers to decide as to the advisability of their separation. There is one feature in which they both agree, and that is in the shape of the sphincter muscle, which from being very narrow below gradually widens as it nears the margin, and has consequently a somewhat club-shaped form. Apparently *P. excavata* has a similar sphincter, though Hertwig has given no figure from which its form may be accurately determined.

13 Paractis lineolata (Dana) M.-Edw.

Plate XXIII, Figs. 34–36.

No. 719. Station 2804. Lat. 8° 16′ 30″ N.; long. 79° 37′ 45″ W. Depth, 47 fathoms. Eight specimens.

The species to which I refer the form about to be described was first mentioned by Dana ('46) as *Actinia lineolata*, and was subsequently referred by Milne-Edwards ('57) to his genus *Paractis*. Verrill ('68), however, removed it from that genus and placed it in the genus *Sagartia*, and Andres ('84), assuming it to be a Sagartid, assigned it to *Nemactis*. In its general appearance the "Albatross" specimens seem to agree with Dana's description, and the absence of acontia show that they are to be replaced in the genus *Paractis*, as it is here understood.

The individuals are small (Pl. XXIII, Fig. 34), and, for the most part, contracted to a hemispherical shape, the tentacles being entirely concealed, as a rule, though in some specimens they are not perfectly infolded. The base, which is adherent, measures in the contracted specimens 0.5^{cm}, and the height of the contracted column is about 0.6^{cm}.

The column is pale in color and is marked with irregular chocolate-brown spots arranged distinctly in rows, and giving the effect of longitudinal bands of brown on a pale ground. There is some variation in the width of the bands, but I could not make out a regular alternation of three narrower bands with a wider one, such as Dana describes. The column wall is perfectly smooth; its mesoglœa below is rather than, but near the margin it thickens rather suddenly. In this thickened region the sphincter muscle (Pl. XXIII, Fig. 36) is imbedded. It occupies in its upper part nearly the entire thickness of the mesoglœa, being separated from the endoderm on the one side, and the ectoderm on the other, by only a small band of mesoglœa. In its lower part it tapers off, and lies nearer the endodermal than the ectodermal surface. The mesoglœa throughout the column wall has a fibrous appearance, and the slightly oval muscle cavities appear to be separated by fine fibrous partitions in transverse sections.

The tentacles are short and obtuse; in one specimen in which they could be seen they were numerous, probably numbering ninety-six, while in another there seemed to be only forty-eight. In this respect the form here described differs from Dana's *A. lineolata*, which is described as having only twenty-four tentacles, arranged in two cycles. The longitudinal muscles of the tentacles, and the corresponding radial ones of the disc, are rather weakly developed and are entirely ectodermal in position. The tentacles seem to cover a large portion of the disc, though, owing to the contracted condition of the specimens, this could not be accurately ascertained.

The mesenteries are few in number, and are arranged in four cycles. The six pairs of the first cycle are alone perfect, those of the second and third cycles are gonophoric, while those of the fourth cycle are

quite small and are destitute of mesenterial filaments. This was the arrangement in a specimen which had about forty-eight tentacles. It will be seen from this that we have an arrangement of the mesenteries which Hertwig considers typical for the Sagartidæ, but a careful search, both in dissected specimens and in sections, for acontia failed to reveal their presence. The longitudinal muscles of the mesenteries form a distinct, though somewhat narrow, pennon (Pl. XXIII, Fig. 35), but the parieto-basilar appears to be very weak.

14. Paractis vinosa, sp. nov.

Plate XXIII, Figs. 37-40; Plate XXIV, Fig. 41.

No. 731. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Many specimens.

The majority of the specimens were contracted, many, however, showing the tentacles protruding (Pl. XXIII, Fig. 37), while in others they were not at all infolded. In the latter the height of the column was 1.4 to 1.6^{cm} and its diameter 1.2 to 1.6^{cm}.

The base is adherent and thin, allowing the insertion of the mesenteries and the dark color of the mesenterial filaments to be seen through it. In some specimens it is covered by a somewhat granular membrane, which is very friable and easily removed in fragments, and seems to be equivalent to the firm basal membrane occurring, for instance, in *Adamsia palliata*.

The column is of a leathery consistence, quite thin near the base, where it is marked with vertical furrows corresponding to the mesenteries, and fading out rapidly above. In color the column wall is white, owing to the absence of ectoderm, the few fragments of this which persist being of a pale brown color. The mesoglœa has a finely granular appearance in sections and is thickest near the margin. The sphincter muscle (Pl. XXIV, Fig. 41) occupies the greater part of this thickened region and is strong. Below it tapers off slowly, extending a long distance down the column wall, lying immediately below the endoderm and passing gradually into the ordinary endodermal circular muscles which are well developed and borne on strong processes. (Pl. XXIII, Fig. 40.)

The margin is smooth, although in some more contracted specimens it may be thrown into a few folds. The tentacles are arranged in about four cycles, and their number appears to be sixty-four They are white and translucent, but probably this is due to the ectoderm having been macerated away from their exposed surfaces, since in some of the strongly contracted specimens the ectoderm of the tentacles contains granules of reddish pigment. The disc is of a deep wine color, as is also the stomatodæum, the pigment granules being so abundant in the ectodermal cells as to completely obscure their structure. The ectodermal muscles of the tentacles and disk are imbedded in the mesoglœa,

occurring in the tentacles at about the middle of that layer. (Pl. XXIII, Fig. 38.)

The stomatodæum is thrown into strong folds, borne on rather stout longitudinal elevations of the mesoglœa. The siphonoglyphes are deep with smooth walls, and the ectodermal cells lining them have the pigment confined to their outer ends and not scattered through their entire thickness as happens elsewhere and on the stomatodæum.

The mesenteries are thirty-two in number, sixteen being perfect and sixteen imperfect. The longitudinal muscles are fairly well developed (Pl. XXIII, Fig. 39), covering the greater portion of the surface of the perfect mesenteries; the parieto-basilar is not, however, particularly strong. Only the imperfect mesenteries are gonophoric, and the reproductive organs are very conspicuous on account of their bright orange color due to the presence of large oil globules in the ova and spermatozoa mother cells. The mesenterial filaments are, like the disc, of a deep wine color, the general endoderm being colorless.

In its coloration, so far as this can be determined, this form comes close to *Paractis rubus* obtained by the Wilkes Exploring Expedition at Valparaiso. The very different habitat of the *Albatross* form, which is an inhabitant of deep water and the uncertainty of an indentification of an alcoholic specimen with a form described as seen living and without any characteristic anatomical features, has induced me to consider for the present the *Albatross* form as distinct.

Genus **ANTHOLOBA**, Hertwig.

Paractidæ with a large number of short tentacles covering the greater portion of the disc; margin of the disc lobed as in *Metridium*. Sphincter strong, prolonged a long distance down the wall.

Hertwig ('82) established this genus for a form previously referred to the genus *Metridium*, and which bears strong resemblance to the forms properly belonging to that group, at least in so far as the margin and the tentacles are concerned. On the other hand, Hertwig has shown that in this case the external similarity is accompanied by such differences in internal organization that the establishment of a new genus and the reference of this to the family Paractidæ is necessary.

15. **Antholoba reticulata**, (Dana) Hert.

Synonyms.—*Actinia reticulata*.—Dana U. S. Expl. Exped., 1846.
Metridium reticulatum.—Milne-Edwards, 1857. Verrill, 1868.
Actinoloba reticulata.—Gosse, 1860. *Antholoba reticulata*.—R. Hertwig, 1882.

Nos. 737, 738. Station: Port Otway, Patagonia. Littoral. Two specimens.
No. 739. Station: Lota, Chile. Littoral. One specimen.
No. 740. Station: Charles Island, Galapagos Archipelago. Littoral. One specimen.

I have very little to add to the description Hertwig has given of this form. I do not find, however, that the margin of the disc is "swollen like a pad," but on the contrary the uppermost portion of the column

wall is in some specimens thinner than it is farther down. The presence of a pad may be due to contraction.

The sphincter muscle, as Hertwig pointed out, extends from the upper to the lower end of the wall. Its shape may be of generic importance, since it does not present the sudden widening near the margin which is to be seen in the forms I have referred to the genus *Paractis*, but tapers off very gradually indeed as it passes down the column.

The specimens I examined did not possess reproductive organs, so that I can not decide the question Hertwig has raised regarding the hermaphroditism of this form.

Genus **Actinernus**, Verrill.

Paractidæ with thick column wall; margin lobed; tentacles short, situated near the margin, the mesoglœa thickened toward their bases, so as to give them a more or less bulbous appearance. Sphincter muscle rather weak (sometimes absent?).

The genus *Actinernus* was established by Verrill ('79) for a deep-sea form obtained off the more northern portion of the east coast of the United States. Verrill's definition and description speak of the margin below the tentacles being "divided into acute lobes or teeth continuous with the body wall," the tentacles being adnate to these teeth. This is the appearance which *Actinernus nobilis* presents, but I have preferred to speak of the teeth as thickenings of the mesoglœa of the bases of the tentacles, since this more nearly describes what obtains in *A. plebeius*, and probably also in *A. saginatus*. The sphincter muscle is quite weak in *A. plebeius*, as will be seen from the following description, and apparently is wanting in *A. nobilis*, being indistinguishable with a powerful lens. This character offers a marked difference, independent of the nature of the tentacles between this genus and *Antholoba*.

The similarity which the figure of *Polysiphonia tuberosa* given by Hertwig ('82) shows to an *Actinernus* is very striking and suggests its possible reference to the latter genus. The lobed margin, the basally swollen tentacles, the disc marked with radiating grooves, the chalice-like shape of the column, are all similarities which attract attention. The sphincter muscle, too, though differing in shape from that of *A. plebeius*, to be described below, is nevertheless mesodermal and by no means powerful. The principal characteristic upon which Hertwig relies in the establishment of the genus is found in the rather large openings at the tips of the tentacles. Such openings are known to be of frequent occurrence, and their enlargement within certain limits, unaccompanied by a marked abbreviation or other alteration of the tentacles, can not be considered sufficiently distinctive for the formation of a new genus. It seems to me that a reference of *Polysiphonia tuberosa* to Verrill's genus *Actinernus* will place it with forms to which it is far more closely related than it is to *Polystomidium*. (See Appendix, p. 209.)

16. Actinernus plebeius, sp. nov.

Plate XXIV, Figs. 42-45.

No. 711. Station 2791. Lat. 38° 08′ S.; long. 75° 53′ W. Depth, 677 fathoms. One specimen.

The body is calyciform and measures about 5cm in height, with a diameter of about 7cm at the disc. The base on the other hand measures only 2.5cm in diameter. It was probably adherent, though from its great distortion in the single specimen it is difficult to be certain what its character may have been.

The column wall is rather soft in consistency, though relatively thick, and its surface being somewhat torn into threads has a rather ragged appearance. The ectoderm is almost entirely macerated away, but the few fragments that remain show that it was of a chocolate brown color. The sphincter is embedded in the mesoglœa, not far from its endodermal surface. It extends some distance down the column wall, but is very narrow. In sections (Pl. XXIV, Fig. 43) it is seen to consist of a series of cavities placed one above the other, for the most part in a single row, each cavity being separated from its neighbor by a distinct partition of mesoglœa. Each cavity is occupied by a mesoglœal network of fine fibre, in the circular or oval interstices of which the muscle cells are arranged.

The margin is tentaculate and wavy or lobed in outline. The tentacles are about ninety-six in number and are arranged in two or three cycles at the margin. They are of a purplish-brown color and are short and slender, each being provided at the outer surface of its base with a marked mesoglœal thickening (Pl. XXIV, Fig. 42), which extends a short distance upwards towards the tip upon the outer surface of the tentacle. The longitudinal muscles are weak and are not embedded in the mesoglœa.

The disc is concave and of a wine-purple color and is marked with radiating ridges, due to the roofs of the inter- and intra-mesenterial spaces being pouched out. The radiating muscles are ectodermal and not at all embedded in the mesoglœa.

The mouth forms an elevation at the center of the disc. It is provided with two well-marked siphonoglyphes. The stomatodæum is longitudinally ridged, the walls of the deep siphonoglyphes being on the other hand smooth. The ectoderm of the stomatodæum is of a deep wine-purple color.

The mesenteries are arranged in four cycles, though indications of a fifth and sixth cycle were present, neither of them being, however, perfect. In a sextant of the wall examined only one pair of mesenteries of the sixth cycle was present, and five pairs, instead of eight, of the fifth cycle. Only the six pairs of mesenteries of the first cycle are perfect, and only the mesenteries of the third and fourth cycles are gonophoric. The musculature, both longitudinal and parieto-basilar, is very weak. What corresponds to the muscle pennon is very low, the mesoglœa being raised into short, blunt processes which carry the muscle cells and give

to the surface of the mesentery on which they occur a crenate appearance in transverse sections (Pl. XXIV, Fig. 44). The endoderm of the mesenteries and that of the body wall is of a purplish-brown color, paler than the stomatodæum, while the mesenterial filaments, in whole or in part, have the same deep wine color which has been described for stomatodæum and disc. The mesoglœa of the reproductive region of the gonophoric mesenteries is much thickened, as is shown in Pl. XXIV, Fig. 45.

Genus ACTINOSTOLA, Verrill.

Paractidæ usually of large size, with firm, leathery wall, which may be somewhat corrugated or folded, but is not furnished with verrucæ. The margin is not lobed and is tentaculate; the tentacles are short and stout, fluted and with their longitudinal musculature embedded in the mesoglœa. Sphincter well developed, extending a considerable distance down the column wall and not expanding abruptly above.

The genus Actinostola was established by Verrill ('83) for a species which he had previously ('82) described as *Urticina callosa*. In his description of the genus he states that the column is "covered with large, irregular tubercles not having the power of adhering to foreign substances," and in the description of the species ('83) he says: "The surface of the column is usually more or less covered with low, irregular, often flattish verrucæ, which become more and more prominent and sometimes form longitudinal[series or crests on the upper part, but fade out to mere wrinkles toward the base." In specimens of *A. callosa*, which I have, through the kindness of Mr. Rathbun, been able to examine, I could find nothing that could be properly termed verrucæ, or even tubercles, though the surface of the column wall was more or less corrugated, resembling in some specimens beaten silver, and bore irregular ridges of mesoglœa near the margin. The *Albatross* specimens present the same appearance, though in one case the corrugations are sufficiently strong to give an almost warty appearance to the column.

Verrill considers the genus *Actinostola* to be allied to *Bolocera*, *Urticina*, and especially to *Actinauge*. What the genus *Urticina*, may embrace remains to be seen, but the other two genera mentioned have certainly only very remote affinities with *Actinostola*, *Bolocera* being related to the Antheadæ, and *Actinauge* one of the Sagartid genera.

17. Actinostola callosa, Verrill.

Plate XXIV, Fig. 46; Plate XXV, Figs. 47–52.

Synonym:—*Urticina callosa*, Verrill. 1882.

Nos. 714–715. Station 2792. Lat. 0° 37′ S.; long. 81° 00′ W. Depth, 401 fathoms. Four specimens.

No. 721. Station 2807. Lat. 0° 24′ S.; long. 87° 06′ W. Depth, 812 fathoms. Two specimens.

No. 723. Station 2818. Lat. 0° 29′ S.; long. 89° 54′ 30″ W. Depth, 392 fathoms. One specimen.

The *Albatross* specimens denoted above I can not distinguish from Verrill's *A. callosa*, with authentic specimens of which I have carefully

compared them. They measure about 8^{cm} in height, with a diameter of 5.5^{cm}. Most of the specimens (Pl. XXV, Fig. 47) are only partially contracted, allowing the tentacles to partially protrude, but in some they are entirely concealed from view.

The base is flat, marked with fine radiating lines, and has the limbus folded back over its edges in all the specimens. The column is nearly cylindrical, and slightly smaller above than below. Its wall has a firm, parchment-like consistency, and is variously corrugated, in part owing to contraction. In the more fully expanded specimens the surface has somewhat the appearance which beaten silver or other soft metal presents, while in others the corrugations may be sufficiently pronounced as almost to justify the designation of irregular tubercles. There are, however, no indications of verrucæ. Below the margin the mesoglœa is rougher than elsewhere, and is raised into irregular ridges. The column wall has a snowy white appearance, the ectoderm in all the specimens having almost disappeared; the fragments of it which remain in some specimens seem to indicate that it was of a pale, brownish-purple color. The sphincter (Pl. XXV, Fig. 51) is well developed and extends a considerable distance down the column wall. In its upper part it does not occupy the entire width of the column wall, but lies throughout its course nearer the endodermal surface than the ectodermal, its cavities passing, in fact, directly into the ordinary circular musculature of the endoderm. It does not expand suddenly above, but its upper part, though larger than the middle region, tapers off very gradually as it is traced downwards. In its upper part the closely packed muscle cavities show a tendency to be arranged in longitudinal bands (Pl. XXV, Fig. 52) separated from one another by streaks of nearly homogeneous mesoglœa, and recalling the arrangement which Hertwig ('82) has described for his *Dysactis crassicornis*.

There is no well-defined margin, the tentacles being inserted upon it. They are rather numerous, situated close to the margin, and are short and stout, with well-marked pores at their extremities. They have a more or less decided pink or salmon color, and are rather indistinctly longitudinally fluted. Their longitudinal musculature is imbedded in the rather thick mesoglœa (Pl. XXV, Fig. 48), as is also the radial musculature of the disc. This portion of the body is smooth and concave and has the same pinkish color which occurs in the tentacles. The mouth is wide, and the stomatodæum is about half the length of the body. It is longitudinally ridged, and has two well-marked, deep siphonoglyphes with smooth walls, which are continued down below the lower edge of the stomatodæum, almost to the base.

Twenty-four pairs of mesenteries reach the stomatodæum, but twelve of them are united to the stomatodæum to a less extent than the other twelve. In addition to these there is another cycle of twenty-four imperfect pairs, which may be counted as the fourth cycle, while the fifth cycle of forty-eight pairs, also imperfect, presents the anomalous con-

dition of one mesentery of each pair being much more highly developed than its fellow (Pl. XXV, Fig. 46). One of each pair is quite small, without reproductive organs and mesenterial filaments, and hardly projects above the column endoderm, while its fellow is fairly broad, and carries reproductive organs and a mesenterial filament. A similar disparity, though less marked, is to be found in the pairs of the fourth cycle, but I could not distinguish it in the third cycle. The relation of the small to the large mesentery of each of the unequal pairs seems to be constant, and is shown in the diagrammatic figure (Pl. XXIV, Fig. 46). It will then be seen that in the fifth cycle (V) the small mesenteries are those nearest the mesenteries of the fourth cycle (IV), while in the fourth cycle the strongest mesenteries are those nearest the pairs of the first and second cycle. A few irregularly disposed mesenteries of the sixth cycle could also be seen. The mesenteries of the fourth and fifth cyles are gonophoric.

As regards the musculature of the mesenteries, it is not very strongly developed. At the base of each mesentery (Pl. XXV, Fig. 50) there is a strong development of muscle processes on both sides, producing a basal muscle (*bm*) similar to what occurs in the Edwardsiæ, and to a less extent in many Hexactinians. In the mesoglœa of the basal region of the mesenteries of the first three cycles some cavities are to be observed similar to, but less highly developed, than those already described for *Bolocera occidua*, and like those developed in connection with the parieto-basilar muscle (*pbm*), which forms a slight projection on one side of the base of the mesenteries. The longitudinal muscles cover all the muscular portion of the mesenteries in an almost uniform layer, only toward the inner edge of the muscular region becoming longer and forming a rather weak muscle pennon (Pl. XXV, Fig. 49). The muscle processes, especially in the pennon, show a tendency to be arranged in groups on more or less distinct blunt processes of mesoglœa.

Amongst the *Challenger* material *Dysactis crassicornis* presents certain features of marked similarity to *Actinostola callosa*. The general arrangement of the muscle cavities of the sphincter muscle seems to be identical in the two forms, and the peculiar arrangement of the mesenteries of the younger cycles shows interesting similarities. There are, however, certain differences in the arrangement, which have made me hesitate to identify the two forms, though I am inclined to believe that *Dysactis crassicornis* is to be properly referred to the genus *Actinostola*, and that it is even probable that it may be identical with *A. callosa*. There can be little question that its reference to Milne-Edwards' genus *Dysactis* is incorrect, since we know that two at least of the forms referred by its author to it, *D. annulata* (Lesueur) and *D. biserialis* (= *Aiptasia conchii* Gosse), are Sagartids, while *D. chilensis* is also referred to that family by Verrill and Andres. If, therefore, the forms referred to Milne-Edwards' genus are Sagartids it

can scarcely be proper to associate with them Paractids. In cases like this where the definition is imperfect we have to interpret the genus from the forms which have been assigned to it and not *vice versâ*, and a more perfect definition of the genus *Dysactis* will include a mention of the occurrence of acontia and cinclides. (See Appendix p. 209.)

18. Actinostola excelsa, sp. nov.

Plate XXVI, Figs 53–56.

No. 696. Station 2770. Lat. 48° 37′ S.; long. 65° 46′ W. Depth, 58 fathoms. One specimen.

No. 698. Station 2771. Lat. 51° 34′ S.; long. 68° 00′ W. Depth, 50½ fathoms. Two specimens.

This very striking form (Pl. XXVI, Fig. 53) measures about 6 cm in height and from 5.5 to 6 cm in diameter. The base is evidently adherent and the limbus is not folded over it, as was the case in *A. callosa.*

The column is cylindrical, narrowing slightly towards the margin, and is apparently capable of little contraction. Its walls are firm, and for the most part smooth, though in contracted specimens irregular longitudinal ridges are to be seen below the margin; these, however, seem to be due to the state of contraction. The ectoderm of the column has a pale brown or buff color; where it has been macerated away the subjacent mesoglœa is seen to be cream white. The sphincter muscle (Pl. XXVI, Fig. 54) is fairly strong, but nevertheless is unable to overcome the resistance offered by the firmness of the column mesoglœa, so that in none of the specimens are the tentacles concealed from view. In shape the sphincter differs markedly from that of *A. callosa.* It forms a delicate network, occupying almost the entire thickness of the mesoglœa in its upper half, and its inner surface passes into the general circular musculature of the column wall. There is no tendency for the muscle cavities to arrange themselves in longitudinal rows as in *A. callosa*, but rather in horizontal lines perpendicular to the surface of the column. The column wall is less thick in its uppermost part than a little lower down, and consequently the thickest portion of the sphincter is below its uppermost edge, in fact almost half-way down. In its lower part it is thin, lying close to the endodermal surface of the mesoglœa, and is prolonged downwards some distance in this condition, gradually becoming lost in the muscle processes of the circular musculature of the column wall.

There is no definite margin, the tentacles occurring at the junction of the disc and column wall. They are rather numerous, numbering perhaps one hundred and ninety-two, and are short and stout, with pores at their extremities. They are longitudinally fluted, and also transversly grooved, so that the surface seems much corrugated. The mesoglœa of the tentacles is almost entirely occupied by the longitudinal muscles

(Pl. XXVI, Fig. 56); in the elevations which give rise to the flutings, however, it has a very delicate structure resembling greatly typical areolar tissue with its connective tissue corpuscles.

The mouth is large; the stomatodæum is irregularly ridged longitudinally, and the siphonoglyphes are deep and prolonged below the lower level of the stomatodæum.

The mesenteries are arranged in ninety-six pairs, of which only those of the first two cycles, twelve in all, are perfect. These, together with the mesenteries of the third cycle are sterile, the reproductive organs occurring only on the mesenteries of the fourth and fifth cycles. The longitudinal musculature (Pl. XXVI, Fig. 55) is fairly strong but does not form any distinct pennon upon the surface of the mesentery. The muscle processes show a tendency, especially in the basal portion of the mesentery, to be grouped upon low elevations of the general mesoglœa. The parieto-basilar muscle (*pbm*) is well developed and forms a decided projection upon the basal portion of the mesenteries, which portion, where the parieto-basilar occurs, contains a number of cavities, evidently developed, as in *B. occidua*, in connection with the growth of the muscles.

19. Actinostola pergamentacea, sp. nov.

Plate XXVI, Figs. 57 and 58; Plate XXVII, Figs. 59–63.

No. 695. Station 2769. Lat. 45° 22′ S.; long. 64° 20′ W. Depth 51½ fathoms. Five specimens.

These specimens (Pl. XXVI, Fig. 57), which seem to belong to the genus *Actinostola*, are very much macerated, the tentacles having dissolved into shreds, so that it is impossible to ascertain their shape or structure. The specimens measure 3^{cm} in height and 2^{cm} in diameter.

The base is evidently adherent and larger in diameter than the column. This is almost cylindrical, enlarging somewhat at the margin and limbus. Its walls are smooth, firm, and parchment-like, being brittle rather than tough, and readily broken. It is pure white in color, the ectoderm, however, being entirely absent. The sphincter Pl. XXVII, Fig. 59) resembles in general appearance that of *A. excelsa*, but is by no means as strong. None of the specimens show the slightest trace of the margin being infolded over the tentacles, and this is not remarkable, considering the stiffness of the column mesoglœa.

The tentacles seem to have been numerous, perhaps one hundred and ninety-two, though this is merely an estimate, since they are too badly macerated to allow of a count. Their longitudinal musculature is imbedded in the mesoglœa in a number of small cavities (Pl. XXVII, Fig. 60). The disc is roughened by radiating rows of small tubercle-like elevations, and the radial musculature resembles that of the tentacles, though in one specimen the cavities were elongated and separated by narrow trabeculæ of mesoglœa, presenting the appearance shown in Pl. XXVI, Fig. 58.

The mouth is prominent. The siphonoglyphes are deep and longer than the stomatodæum. All the mesenteries, with the exception of the youngest cycle, are perfect; there are apparently five cycles, the mesenteries of the third and fourth cycles being gonophoric. The muscle processes of the longitudinal muscles are developed over the entire muscle-bearing surface of the mesentery, increasing slightly towards the inner edge of this surface to form a weak pennon. In the upper part of the mesenteries, above the region where the parieto-basilar occurs the parietal part of the mesentery is somewhat thickened, and the muscle processes in this thickened region are somewhat more numerous and more slender than elsewhere (Pl. XXVII, Figs. 62–63). Over the general surface of the mesenteries the processes are comparatively stout (Pl. XXVII, Fig. 61). The parieto-basilar muscle presents essentially the same characteristics as in *A. callosa*, the mesoglœa in the region occupied by it having small cavities enclosed in it. As in *A. callosa* also a basal muscle is present (Pl. XXVII, Fig. 62), but it has relatively but a slight development.

Genus **PYCNANTHUS**, gen. nov.

Paractidæ of moderate size, with thick, though rather soft, column wall; no tubercles or verrucæ, though the upper portion of the column is marked by more or less distinct longitudinal ridges running to the bases of the tentacles. Margin tentaculate, not lobed; tentacles short, but slender, not swollen at the base. Sphincter muscle rather weak, lying close to the endoderm.

I have established this genus for the reception of a form which does not seem to be assignable to any of the genera of Paractidæ as they are here understood. The weak sphincter and slender tentacles exclude it from the genus *Actinostola*; the absence of a marked dilatation of the sphincter and the occurrence of ridges upon the upper part of the column, running to the bases of the tentacles, show it to be distinct from the genus *Paractis*. The ridges are hollow, with rather delicate walls, and resemble those found in certain Sagartids which possess a capitulum. The absence of acontia, however, precludes the association of the form about to be described with the Sagartidæ.

20. **Pycnanthus maliformis**, sp. nov.

Pl. XXVII, Figs. 64–67; Pl. XXVIII, Fig. 68.

No. 728. Station 2839. Lat. 38° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Fourteen specimens.

The largest specimens (Pl. XXVII, Fig. 64), measure 2.5cm in height, and 3.3cm in diameter. All are contracted, the tentacles and upper portion of the column being infolded. The alcohol in which they are preserved is stained a very distinct yellow, and when specimens are placed in fresh alcohol this quickly assumes the same coloration. The pig-

ment seems to saturate the alcohol quickly, fresh alcohol continuing to extract more of it even after several changings.

The base is thin, allowing the mesenteries to be seen through, when the more or less membranous brown coating which covers it is removed. The margin of the base in all the specimens is concealed by the limbus being reflected over it.

The column is white, the ectoderm having been entirely removed, and is irregularly corrugated; no tubercles or verrucæ are present, however. The mesoglœa is very thick, measuring in one specimen at a point a short distance above the limbus as much as 3.5^{mm} in thickness. It is not, however, harsh or resistant to the touch, but on the contrary is rather soft, and in structure is almost homogeneous or hyaline, with small cells scattered through it. Towards its upper part are a number of ridges, which are hollow and thin-walled, and pass to the bases of the tentacles of the outer row. The sphincter muscle extends a considerable distance down the column wall (Pl. XXVII, Fig. 65), but is throughout thin. It lies throughout its entire extent close to the endodermal surface of the mesoglœa, passing into the circular musculature of the column wall. Above it is very slightly thickened, but not at all as in *Paractis*. The muscle cavities for the most part show little tendency towards any regular arrangement (Pl. XXVII, Fig. 66), though towards the lower edge of the muscle they are somewhat elongated, and arranged in lines nearly perpendicular to the surface of the mesoglœa.

The margin is tentaculate. The tentacles are arranged in four cycles, 12, 12, 24, 48. The ridges upon the upper surface of the column run to the bases of the outer tentacles, and from the bases of the inner ones ridges extend outward, but only for a short distance, losing themselves before they reach the outermost cycle of tentacles. The mesoglœa of the bases of the tentacles is only very slightly thickened, and the longitudinal muscles of the tentacles are imbedded in the mesoglœa. In the disc the radial muscles are mesoglœal and are arranged in a very characteristic manner (Pl. XXVIII, Fig. 68), recalling what Hertwig has figured for *Dysactis crassicornis*. Opposite the insertions of the mesenteries into the disc the radial musculature is interrupted so that it is divided into radial bands, each separated from its neighbors by a depression on the surface of the disk. Each radial band appears to be a single flattened cavity, traversed by perpendicular, somewhat branching, fine trabeculæ of mesoglœa, which divide the large cavity into a great number of smaller ones, in which lie the muscle cells.

The stomatodæum is longitudinally ridged and is continued downwards almost to the base. The siphonoglyphes are deep, and near their lower extremities two transverse folds, lying one above the other, project across the cavity of each, closing it below.

The mesenteries are arranged in ninety-six pairs, the youngest cycle of forty-eight pairs being indistinguishable to the naked eye. The twelve pairs of the first two cycles are perfect, the twelve tertiaries

also reaching the stomatodæum, but being united to it to a less extent than are the primaries and secondaries. The reproductive organs are borne upon the mesenteries of the third and fourth cycles. The longitudinal muscles of the mesenteries do not form a distinct pennon, (Pl. XXVII, Fig. 67). In the perfect mesenteries the processes which support the muscle cells arise in bunches from stout elevations of the mesoglœa. The parieto-basilar muscles extend only a very short distance up from the base, and in sections through the middle of the column are not to be distinguished. No acontia appear to be present. The endoderm is considerably macerated, so that the form of these structures, if they existed, could not be made out; I base my statement as to their absence in the absence of nematocysts in the tissues lying in the body cavity, the macerated remains of the mesenterial filaments.

Genus **CYMBACTIS**, gen. nov.

Paractidæ of moderate size, crateriform in shape, with the mesoglœa of the column wall rather thick but soft; surface of column rugose in contracted forms, but without verrucæ or warts; no capitulum with longitudinal ridges. Sphincter muscle relatively weak, lying close to the endoderm; margin not lobed, tentaculate; tentacles numerous, situated close to the margin, short, slender, not bulbous at the base.

The form for which I establish this genus approaches somewhat in appearance an *Actinernus*, having the short tentacles concentrated near the margin as in that genus, a large portion of the disc being left uncovered. The absence, however, of any bulbous enlargements or thickening of the mesoglœa at the bases of the tentacles induces me to place the form in a separate genus, which, from the cup-shaped form of the specimens to be referred to it, I name Cymbactis (κύμβη—a drinking cup).

21. **Cymbactis faeculenta**, sp. nov.

Plate XXVIII, Figs. 69–71.

No. 732. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Six specimens.

All the specimens seem to be immature, as I did not succeed in finding reproductive cells in those I examined. The largest specimen measured 2 ^{cm} in height, with a diameter at the margin of 2.5 ^{cm}, and at the base of 1.3 ^{cm}.

The base is adherent. The column which gradually enlarges from the base to the margin, producing a more or less cup or vase shaped form, (Pl. XXVIII, Fig. 69), is rather thick-walled, but soft to the touch, the mesoglœa not being of fibrous structure but hyaline. The ectoderm has macerated away from all the specimens, but when a trace of it is

left it may be seen to be of a chocolate brown color. In consequence of the absence of ectoderm the column is white, though in some of the smaller specimens, in which the mesoglœa is thinner, the color was a dark slate blue, due to the dark pigment of the endoderm showing through. The column wall is very rugose, probably due to contraction, and shows no signs of possession of verrucæ or permanent warts. The sphincter (Pl. XXVIII, Fig. 70) is weak, compared to what it is in most Paractids, and is for the most part confined to a thin layer immediately external to the endoderm. Toward its upper part a few scattered and isolated cavities are to be seen deeply imbedded in the mesoglœa, apparently undergoing degeneration.

In the contracted specimens the tentacles are concealed partially by an infolding of the margin, but this infolding is not carried far enough to conceal the disc and the wide mouth. The tentacles are situated close to the margin in about five cycles, and are apparently about ninety-six in number. They are short, acuminate, and slender. Their ectoderm and that of the disc seems to be of the same color as that of the column. The radial musculature of the disc and the longitudinal muscles of the tentacles are imbedded in the mesoglœa. The mouth is wide and leads into a stomatodæum which reaches nearly to the base. The siphonoglyphes are well developed.

The stomatodæal ectoderm and the endoderm throughout is of a dark wine color; the pigment occurs in the form of granules scattered through the cells, and is insoluble in alcohol, turpentine, and xylol. The mesenteries appear to number twenty-four pairs, half of which are perfect. Their mesoglœa is thick, and there is no special muscle pennon, the longitudinal muscles being comparatively weak (Pl. XXVIII, Fig. 71). No reproductive organs could be made out.

Family SAGARTIDÆ.

Actininæ with sphincter muscle imbedded in the mesoglœa, usually with only a few perfect mesenteries; furnished with acontia.

According to the above definition the Sagartidæ will form a group parallel to the Paractidæ, and distinguished from them by the presence of acontia. Whether this is a character of sufficient importance for a family diagnosis and indicates phyletic affinity of all the forms which present it future observation must determine. It seems at present convenient to associate all Actininæ with acontia in a single family, though it may be necessary to recognize in the family various subfamilies, as several authors have already done. Haddon ('89) has discussed the limitations of the family as they have been placed by various authors, and accordingly it will be unnecessary to repeat such a discussion here. The same author has established a new subfamily Chondractininæ, which may, for the present, be adopted, though it seems not improbable that it is practically identical with the sub-

family, Phellinæ, which was separated from the Sagartidæ by Verrill ('67), and recognized by Andres ('83) and Hertwig ('88). I have in a previous paper (1889) proposed the separation of the Sagartidæ into the subfamilies Sagartinæ and Phellinæ, but since Haddon's subfamily is somewhat more extensive than and probably may include the genus *Phellia*, it seems advisable to adopt it.

Subfamily SAGARTINÆ.

Sagartidæ with the ectoderm naked, the acontia being emitted from the mouth and through the column wall, in which definite openings (cinclides) are present (always?) for their emission.

Genus **SAGARTIA**.

Sagartinæ with smooth column destitute of verrucæ and with no special arrangement of the cinclides; margin tentaculate; tentacles concealed in contraction, the sphincter being fairly strong.

In alcoholic specimens it is not always possible to be certain as to the arrangement of cinclides, and some of the forms which I assign to this genus may possibly be more properly referable to some other Sagartian genus. The absence of verrucæ, the tentaculate margin, and the concealment of the tentacles in contraction are points which assist in determining the assignment of a form to this genus.

22. **Sagartia lactea**, sp. nov.

Plate XXVIII, Figs. 72–75; Plate XXIX, Fig. 76.

Nos. 710–956 Station 2785. Lat. 48° 09′ S.; long. 74° 36′ W. Depth, 449 fathoms. Numerous specimens.

The specimens were adherent to a dead coral, and were for the most part strongly contracted, forming a low rounded cone with a widely expanded base (Pl. XXVIII, Fig. 72). In these the tentacles were completely concealed, but in a few forms the contraction was not so great, and the tentacles were partly visible. Such specimens measured from 1.1 to 1.3^{cm} in height, with a diameter at the upper part of the column of about 1.1^{cm} and at the base of about 1.5 or 2^{cm}.

The base is provided with a brown membranous covering, evidently a secretion of its ectoderm cells. The ectoderm in all the specimens has been entirely macerated away from the mesoglœa of the column wall, which has a milky white color. It is tolerably firm and parchment like, though not very thick, and is for the most part smooth, though in some specimens more or less wrinkled by contraction. In the upper part of the column delicate longitudinal ridges can be seen, which become stronger as they approach the margin and recall the capitular ridges of *Actinauge;* they are not, however, visible in the less contracted specimens, and seem to be produced by the contraction of the sphincter, and to be due to a certain extent to the pergamentaceous

consistency of the mesoglœa. The sphincter muscle (Pl. XXVIII, Fig. 73) is fairly strong and in its upper part occupies nearly the whole thickness of the mesoglœa, being separated from the ectoderm and endoderm by thin layers of mesoglœa. It is composed of very numerous more or less circular (in section) cavities lined with muscle cells, and so closely arranged as to be separated only by very narrow bands of fibrous mesoglœa (Pl. XXIX, Fig. 76). In consequence of their arrangement this portion of the column wall, under low magnification seems to have a reticular structure. The sphincter extends a considerable distance down the column, becoming thinner and having the cavities more separated in its lower part, until finally they are scattered singly or in pairs in the lowermost portions.

The tentacles are slender and acuminate, and their number I estimate at slightly below one hundred, though I was unable to make a definite count. They have a cream-white color. Their longitudinal musculature is ectodermal, and the mesoglœal supporting processes are fairly strong. Large numbers of nematocysts occur in their ectoderm.

The disc has strong radiating ridges corresponding to the endocœls of the first and second cycles of mesenteries, and has its radiating musculature ectodermal, like the longitudinal muscles of the tentacles. In the ectoderm of the disk are numerous oval or spherical bodies, of a granular structure, which stain deeply with borax carmine. I could not detect a nucleus in any of them. Their abundance and general appearance seem to preclude the idea that they are foreign bodies, and the only explanation as to their significance which suggests itself is that they are glandular bodies. The preservation of the ectoderm was not sufficiently perfect, however, to allow of any certainty on this point.

The stomatodæum is rather small in diameter, and possesses about ten longitudinal ridges; in some specimens there was only a single siphonoglyphe, but whether this is a characteristic arrangement I can not say. Judging from the observations of G. F. and A. Y. Dixon on various species of *Sagartia* ('88) and my own ('91) on *Metridium marginatum*, it is more probable that there is a variation in the number of siphonoglyphes, some specimens possessing only one and others two. As in the case of *Metridium* and *Sagartia venusta*, there is only one pair of directives in those specimens of *S. lactea* which possess a single siphonoglyphe.

The mesenteries are arranged upon the decamerous plan, there being in all ten pairs of perfect mesenteries, all of which, with the exception of the directives, are gonophoric. I was in hopes that it might be possible, from the distribution of the reproductive organs upon the mesenteries, to ascertain which of the mesenteries of the second cycle it was which had failed to develop, the normal hexamerous arrangement being thus converted into a decamerous one; but in this I was disappointed. Counting the ten perfect pairs of mesenteries as representing two cycles, one of which, the second, is not quite complete, there is present

a third cycle of ten pairs, all gonophoric, a fourth one of twenty pairs destitute of reproductive organs, and indications in some exocœls of a fifth pair, which is, however, incomplete. The mesenteries are thin, and their musculature not very markedly developed (Pl. XXVIII, Fig. 74). The acontia are fairly numerous and show a large development of gland cells (Pl. XXVIII, Fig. 75). The convex surface of an acontium is occupied mainly by nematocysts, between which a few scattered coarsely granular gland cells occur, while immediately below the nematocysts these cells are very abundant, as they likewise are at the sides and towards the concave surface. For the most part they stain deeply with borax carmine, though many—probably those in which the glandular products are more completely elaborated—refuse to take the stain and show a yellow color. In one specimen I found the acontia protruding from the mouth, but could not find any emitted through the column wall, although in sections through the wall fine canals can be readily observed which have no appearance of being artefacts, and probably are cinclidal. I could discover no definite arrangement of these canals.

There are three interesting features about this Sagartid: (1) Its decamerism. There are ten pairs of perfect mesenteries, and the imperfect mesenteries are arranged symmetrically to these ten, those of the next subordinate cycle developing in the exocoels between adjacent pairs of perfect mesenteries. I have already suggested ('91) that this condition probably arises by the suppression of a pair of mesenteries of the typical second cycle, so that this cycle consists of four pairs only instead of six. Whether or not it is the same pair that is suppressed in each case in which decamerism occurs can not be stated at present. In the decamerous Halcampids it has been seen that it is the mesenteries on either side of the sulcular directives that have disappeared, but it is not impossible that in sporadic cases of decamerism, such as we have in *S. lactea*, that it is the mesenteries on either side of the sulcar directives that have disappeared, or even the lateral mesenteries of the second cycle. However that may be, it is certain, I think, that we must regard the ten perfect mesenteries of a decamerous form as equivalent to the first and second cycles of a hexamerous form. It follows from this (2) that we have in *S. lactea* another instance of a Sagartid in which more than the six primary mesenteries are perfect. Hertwig ('82) assumed as a character of his family Sagartidæ the presence of only six perfect mesenteries, which were also sterile, but von Heider ('77) had already shown that there were numerous perfect mesenteries in *Cereus pedunculatus*, and F. Dixon ('88) has since shown that in those Sagartias which Gosse considered typical species of the genus there are more than six pairs of perfect mesenteries. It is certainly a fact that the majority of Sagartids whose anatomy we know possess only six pairs of perfect mesenteries, but too many exceptions exist for this peculiarity to be included in the definition of the genus. But not only does *S. lactea* have the mesenteries of the second cycle perfect, but (3) the

mesenteries of the first cycle, with the exception of the directives, are not sterile. Here again we have a feature which places this form outside the pale of Hertwig's genus *Sagartia*, but it shares this distinction together with *Aiptasia* sp? and *Aiptasia pallida*, whose peculiarities in this respect I have already pointed out ('89*a*).

I have considered the form described in the following pages to be the representative of a new species. I do so, however, with considerable hestiation. Several Sagartids have been described from the west coast of America, by Lesson ('30), Dana ('46), Gay ('54), Verrill ('68), and Ridley ('81), but unfortunately the descriptions furnish no sufficient basis for the identification of alcoholic material. The form which Verrill ('68), with some reservations, refers to Lesson's *Actinia nivea* seems to be rather closely related and may be identical, though I should be inclined to doubt, without good evidence, the identity of a shallow water form with one living at a depth of 450 fathoms. It is doubtful, too, whether Verrill's form is really *Sagartia* (*Act.*) *nivea*, since Lesson expressly states that in this form "l'enveloppe est très-lisse, très-douce au toucher et seulment marquée de quelques ondes ou plissures verticales," while Verrill's form has the "integument thin but firm," more nearly resembling *S. lactea* in this respect. It is on account of this uncertainty of definition that I have preferred to consider the *Albatross* form a new species.

23. Sagartia Sancti Matthæi, sp. nov.

Plate XXIX, Figs. 77 and 78.

No. 954*a*. Station, 2764. Lat. 36° 42′ S.; long. 56° 23′ W. Depth, 11¼ fathoms. Three specimens.

The three specimens differ somewhat in external appearance. One is quite small, while the other two were larger, measuring about 0.5^{cm} in height and 0.6^{cm} in diameter. One of the specimens was colored, the column being chocolate-brown in color, the tentacles much darker, but of about the same color. The other two specimens showed no traces of this coloration and may possibly be different species. The anatomical details given below were derived from the study of one of the colorless specimens.

The base is adherent and not much larger than the column (Pl. XXIX, Fig. 77). This is somewhat wrinkled by contraction, but bears no warts or verrucæ. Its wall is rather thin, soft, not parchment-like. In one of the specimens an acontium protruded through the wall, but no cinclides were elsewhere visible. The sphincter (Pl. XXIX, Fig. 78) is narrow, but well developed. In its upper part it occupies the greater part of the thickness of the column wall and tapers off gradually below. In section the muscle-cavities in the upper part are elongated perpendicularly to the surface of the column, becoming gradually more circular towards the lower edge of the muscle.

The tentacles are exposed to a greater or less extent in all the specimens; they are short, and pointed at the apex. They are strongly entacmæous and their number is probably less than one hundred. Their longitudinal musculature is ectodermal and is fairly developed.

The mesenteries, as in the preceding species, are arranged upon a decamerous plan. There are ten pairs of perfect mesenteries constituting the first and second cycles; the third cycle is imperfect, but well developed, while the fourth cycle is considerably smaller. Here and there pairs of mesenteries of the fifth cycle can be seen, but this cycle is not complete. No reproductive organs were present. The longitudinal musculature is fairly well developed on the larger mesenteries, the mesoglœal processes increasing gradually in size towards the inner margin of the muscle and there abruptly diminishing.

24 **Sagartia paradoxa**, sp. nov.

Plate XXIX, Figs. 79–81; Plate XXX, Fig. 84.

No. 692. Station, 2766. Lat., 36° 47′ S.; long., 56° 23′ W. Depth, 10½ fathoms. Several specimens.

In this form (Pl. XXIX, Fig. 79) the base is adherent. The column is longitudinally ridged with fine elevations, and does not bear any tubercles or verrucæ, nor were any cinclides observable, acontia being emitted from the mouth, however, in several specimens. Nearly all the specimens have the tentacles and disc perfectly unretracted, and the stomatodæum is more or less evaginated in many. The specimens have an average height of about 0.8$^{cm.}$, and a diameter of about 0.9$^{cm.}$ The sphincter muscle (Pl. XXIX, Fig. 80) is very well developed, notwithstanding the nonretraction of the tentacles. It occupies the entire thickness of the mesoglœa, and is thickest about the middle, tapering off above and below. The muscle cavities are very numerous, and are separated only by very thin trabeculæ of mesoglœa, so that the column wall in the region of the sphincter has an openly reticulate appearance in longitudinal section.

The tentacles occupy the margin and are very numerous, short and acuminate, and decidedly entacmæous. Their longitudinal musculature and the radial musculature of the disk is ectodermal, the muscle processes being fairly well developed. The disc is smooth. The stomatodæum is longitudinally ridged, and has two siphonoglyphes, one of which, however, seems to be much deeper and more distinct than the other.

The mesenteries present a rather peculiar arrangement in the two specimens of which an anatomical study was made (Pl. XXX, Fig. 84). They are arranged on an octamerous plan. If we consider for convenience in description eight pairs as constituting the first cycle, then the first three cycles (I, II, III) are all perfect, the mesenteries of the third cycle losing their connection however with the stomatodæum about

half-way down. A fourth cycle of imperfect mesenteries is present, but it is not complete. There are two pairs of directives (D), one of which, connected with the deeper siphonoglyphe, is much stronger than the other. The regularity of development of the mesenteries is somewhat interrupted on either side of these smaller directives. Disregarding the rudimentary mesenteries of the fourth cycle, a pair of mesenteries (x) which are perfect succeed on each side these directives, and next there comes a pair (y) belonging to the second cycle, which consists of one perfect and one imperfect mesentery, the latter being nearest the directives. This arrangement occurred on both sides of the directives, and in both the specimens examined, and accordingly is probably normal.

Acontia are present, as above stated. All the mesenteries except those of the fourth cycle and the directives are gonophoric. The longitudinal musculature is well developed (Pl. XXIX, Fig. 8), a marked pennon being present, the various muscle processes of which arise independently from the mesoglœa.

25. **Sagartia crispata** (Bradley) Verrill.

No. 718. Station, 2799. Lat., 8° 44′ N.; long., 79° 09′ W. Depth, 29½ fathoms. One specimen.

The *S. crispata* described by Verrill ('68) was dredged in from 4 to 6 fathoms in Panama Bay, and occurred upon the shell of a large Murex (*Phyllonotus*). The specimen which I identify with it with some hesitation, was found in slightly deeper water in the same locality, and also occurred upon the shell of a good sized Prosobranch, apparently one of the Muricidæ. It is very much flattened in contraction, the margin and tentacles being completely concealed. The base measures about 2.7^{cm} in diameter, and firmly clasps the surface of the shell, which was inhabited by the living mollusk and not by a Pagurid. The column is wrinkled and somewhat roughened by minute elevations produced by contraction, but does not seem to possess any verrucæ. Acontia are emitted through the column wall a short distance above the limbus, but no series of cinclidal tubercles could be made out. The column is marked by numerous, irregularly wavy, longitudinal lines of a chocolate brown color, which are very distinct upon the white ground.

Not wishing to destroy the single specimen I can give no particulars regarding the internal structure.

From the fact that the acontia are emitted a short distance above the limbus it is possible that this form is an *Adamsia*. Its identification with *S. crispata* is necessarily uncertain, owing to there being no opportunities for a thorough comparison of the two forms. The differences between the coloration in this form and Verrill's description of *S. crispata* may be due to preservation.

Genus ADAMSIA Forbes.

Sagartinæ with adherent base, the ectoderm of which secretes a membrane; column without warts or verrucæ, but provided with one or two horizontal series of cinclidal tubercles a short distance above the limbus; margin tentaculate.

26 Adamsia (?) involvens, sp. nov.

Plate XXIX, Figs. 82 and 83; Plate XXX, Fig. 85.

No. 716. Station, 2793. Lat. 1° 03′ N.; long. 80° 15′ W. Depth, 741 fathoms. Twelve specimens.

Every specimen is fully contracted and completely incloses a Gasteropod shell, being wrapped around it in such a manner as to conform itself more or less to the shape of the shell (Pl. XXIX, Figs. 82 and 83). On this account it is difficult to give any accurate measurement of the height of the Actinian, but this may be averaged for the contracted specimens at about 1.5 to 2^{cm}., and the diameter at from 1.25 to 1.5^{cm}. The column is of a pale flesh color, but becoming thinner toward the limbus it has a darker shade, and is here longitudinally streaked with white lines, indicating the lines of insertion of the mesenteries on the column wall. In this thinner region, too, the internal organs shine through. The tentacles are of a salmon color, this tint depending, to a certain extent, and probably entirely, on the bright reddish orange pigment which occurs everywhere in the endoderm. The coloration which these preserved specimens present is entirely independent of any colors which may have been present in the ectoderm, since this layer has entirely disappeared from the surface of the column.

The base incloses the gasteropod shell, and, as it were, forms the opening of the habitation of the mollusk. Its ectoderm secretes a very well-marked chitinous layer, not only over the region in contact with the shell, but also over that which is free from it.

The column wall is smooth throughout and has a parchment-like consistency, the mesoglœa being very fibrous in structure, though rather thin. No cinclidal tubercles could be perceived. The sphincter muscle (Pl. XXX, Fig. 85) is well developed, though not very broad. Toward its upper margin the muscle cavities are in section more or less circular in outline and distinctly separated from one another, but lower down they are more elongated and are separated by narrower partitions, circular scattered cavities lying upon the outer surface. It is separated throughout from the endoderm by a thin layer of mesoglœa. The circular muscles of the endoderm are only slightly developed, the cells being arranged in an almost smooth layer and not supported on well-developed processes of mesoglœa.

The margin is tentaculate, and the tentacles are arranged apparently in three cycles, though their exact arrangement it is difficult to ascer-

tain on account of the contraction of the specimens. They seem to be ninety-six in number, and to be arranged in two cycles of twenty-four each, and one of forty-eight. Their longitudinal musculature is well developed and is entirely ectodermal, supported on strong mesoglœal processes. The mesoglœa of the tentacles does not partake of the fibrous structure of that of the column wall, but is hyaline.

Two siphonoglyphes are present, apparently, and two pairs of directives. There are forty-eight mesenteries, only the six primary pairs being perfect. The secondary and tertiary pairs bear the reproductive elements, those of the fourth cycle being quite small and destitute of mesenterial filaments. The longitudinal muscle processes are fairly well developed, but do not form a very distinct muscle pennon. Acontia are present; in some of the specimens they were emitted from the mouth, but in none did I find them protruding from the column wall.

On account of any failure to discover cinclides it is of course doubtful if this form is correctly referred to the genus *Adamsia*. The shape of the sphincter is decidedly different from that of *Adamsia parasitica*, and *A. polypus* as described by Hertwig, but does not, however, differ so materially from that of *Adamsia Sol* of our eastern coast. My principal reasons for considering *A. involvens* a possible *Adamsia* is its habitat on gasteropod shells and the secretion of a strong chitinous membrane by the ectoderm of the base, features which are, however, of comparatively small value.

Subfamily CHONDRACTININÆ, Haddon.

Sagartidæ with thick column wall, usually with the upper portion (capitulum) different in character from the lower (scapus) and capable of being entirely invected; the scapus provided with an external cuticle and usually nodulated or warty; the sphincter strong and imbedded in the mesoglœa; only the six primary pairs of mesenteries perfect and at the same time nongonophoric; acontia emitted by the mouth only, there being no cinclides.

Genus ACTINAUGE, Verrill.

Chondractininæ in which the capitulum is provided with longitudinal ridges; scapus strongly tuberculate or nodulate, the tubercles near the junction of the scapus and capitulum being usually stronger than those lower down; each tentacle with a bulbous thickening on the outer surface at the base.

This genus was established by Verrill ('83) to receive a form which he believed to be identical with the *Actinia nodosa* of Fabricius. The definition given above contains the essential points of Verrill's definition, with the addition of a mention of the presence of a bulbous enlargement at the base of the tentacles, a feature to which Haddon ('89) has called attention, and made an important factor in the limita-

tion of the genus. In the definition given by Haddon the capitular ridges are limited to twelve, while Verrill expressly states that they are as numerous as the tentacles. From an examination of specimens of the type species I can state positively that there are forty-eight capitular ridges in it, one ridge corresponding to each of the twenty-four more or less distinct rows of tubercles, while a smaller ridge intervenes between each pair of these larger ones. Haddon likewise limits the bulbous enlargements to the bases of the three inner circles of tentacles, but in the type species there is no such limitation in their distribution, all the tentacles possessing the enlargements. The numerical limitations of the ridges and bulbous enlargements must be regarded as of specific but not of generic value.

27. Actinauge Verrillii, nov. nom.

Plate xxx, Figs. 86–89; Plate xxxi, Figs. 90–92; Plate xxxv, Fig. 121.

Synonyms: *Urticina nodosa*, Verrill (1873); *Actinauge nodosa*, Verrill (1883); *Actinauge* (sp.)?, Haddon (1889).

No. 712. Station 2791. Lat. 38° 08′ S.; long. 75° 53′ W. Depth, 677 fathoms. Seven specimens.

No. 734. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. One specimen.

Nos. 733, 735. Station 2839. Lat. 33° 08′ N.; long. 118° 40′ W. Depth, 414 fathoms. Six specimens, young.

No. 724. Station 2818. Lat. 0° 29′ S.; long. 89° 54′ 30″ W. Depth, 392 fathoms. One specimen (much torn).

I have been able, by direct comparison, to identify the specimens marked No. 712 with specimens of *A. Verrillii* from the eastern coast of North America and shall give a detailed account of the structure of these specimens. The specimen No. 734 presents some differences from the typical *A. Verrillii*, and it is possible that it may belong to another species, but I did not investigate the structure of the single specimen, and will content myself with giving a description of its external peculiarities. Nos. 733 and 735 were obtained in the same dredging as No. 734, and are probably young forms of the same species, and call for a brief description. Finally, No. 724 is referred to this species with some hesitation; it is very much distorted and torn, so that it is impossible to examine it satisfactorily. It is possibly the *tuberculosa* variety which Verrill has described as a distinct species, but nothing can be said concerning it.

All the specimens of No. 712 are thoroughly contracted, the tentacles and capitulum being concealed (Pl. xxx, Fig. 89). The column is cylindrical, and covered with well-marked, large tubercles, thickenings of the mesoglœa, which are especially high in the upper part of the column, where they are somewhat square in outline, and arranged more or less definitely in horizontal and longitudinal rows, there being about twenty-four of the latter. Lower down upon the column the

tubercles become much flatter, and toward the base they are represented by slight transversely elongated, narrow elevations, the longitudinal arrangement being nearly lost. The limbus is smooth, the elevations fading out a short distance above it.

The base is much smaller than the column and is deeply concave, a quantity of mud, which evidently served to anchor the animal, being inclosed in the concavity.

The upper part of the column or capitulum does not possess any tubercles, these being limited to the scapus. The uppermost tubercles are usually more pronounced than those lower down, and form a more or less distinct coronal series (Pl. XXX, Fig. 89 *cor*), consisting of twenty-four tubercles. From each coronal tubercle a ridge (*c. r.*), extends across the capitulum toward the bases of the tentacles, and between each pair of these coronal ridges a smaller ridge intervenes, so that the capitulum bears in all forty-eight ridges. They are decidedly prominent, with thin walls, the cavities which they contain communicating with the endocœls. Before reaching the level of the bases of the outermost tentacles each ridge somewhat suddenly increases in height, and more suddenly diminishes, giving rise to a pouch-like structure. The ridges terminate at the bases of the tentacles of the four inner cycles, the tentacles of the outer cycle being situated upon the sides of the intermediate smaller ridges, in the manner indicated in the scheme given on Pl. XXXV, Fig. 121.

When the cuticle is preserved the column has a dark-brown color, but the tubercles are white for the most part, owing to the cuticle having been rubbed off. The capitulum in the alcoholic specimens is colorless; the disc and tentacles, however, are orange or salmon colored, while the stomatodæum is brown.

The mesoglœa of the column wall is thick and delicately fibrous in structure, with a few cells scattered through it. The ectoderm, where present, is covered by the thick cuticle, to which particles of foreign matter adhere. The tubercles are solid elevations of the mesoglœa. The sphincter muscle (Pl. XXX, Fig. 86) is fairly strong, but varies somewhat, both in its thickness and width, in different specimens, the differences not being due to age, as in some cases I have found the muscle much weaker in a large specimen than in smaller ones. It occupies the entire capitular region, and extends a varying distance below the coronal tubercles. Throughout its entire width it is widely separate from the endodermal surface of the column and lies in the scapus very close to the ectoderm. In transverse section (Pl. XXX, Fig. 88) it is seen to consist of more or less circular cavities, traversed by irregular partitions of mesoglœa, though in some cases the cavities are more numerous and smaller, and almost destitute of partitions. Toward the lower edge of the muscle the cavities are in one or two series, but they become more numerous above, but there is no well marked, sudden thickening of the muscle in its upper part. A curious arrangement is found

in the upper part, in some forms at least; the muscle fibres and the cavities instead of being cut across by a transverse section through the muscle, give the appearance of being cut parallel to their course (Pl. XXX, Fig. 87) and the section has the appearance of a horizontal or transverse section through the upper part of the column wall. Furthermore, the cavities, branching and anastomosing with each other, pass toward the ectodermal surface of the mesoglœa, and apparently in some cases come into contact with the ectoderm. This arrangement, as I have said, is not so distinct in some specimens as in others, but is more or less marked in all my preparations.

The tentacles are ninety-six in number and are arranged in five cycles. They are rather short, but slender and pointed. At the outer surface of the base of each there is a bulbous swelling (Pl. XXX, Fig. 89), formed principally of thickened mesoglœa (Pl. XXXI, Fig. 91). The ectodermal musculature, both of the tentacles and of the disc, is rather weak, the mesoglœal process for its support being only slightly developed.

The stomatodæum is long, extending, in the contracted specimens, almost to the base. It has two siphonoglyphes, which are well developed though not particularly deep.

There are twenty-four pairs of mesenteries arranged in four cycles. Only the six mesenterial pairs of the first cycle are perfect. The mesenteries of the second cycle, though imperfect, resemble those of the first cycle in being nongonophoric, the reproductive organs being borne altogether by the mesenteries of the third (Pl. XXXI, Fig. 90) and fourth cycles. In the region of the mesentery occupied by the reproductive elements in female individuals the mesoglœa is greatly enlarged (Pl. XXXI, Fig. 90), the ova (*ov*) being imbedded in the enlargement. This does not occur in the mesenteries of male individuals from the Atlantic coast of North America; all the *Albatross* specimens I examined for this point proved to be females. The longitudinal muscles of the mesenteries are not particularly well developed (Pl. XXXI, Fig. 92), and there is no circumscribed pennon. The low mesoglœal processes tend somewhat to be arranged in bunches of a few arising from a common basis. At the bases of the mesenteries, *i. e.*, at their attachment to the column, there is a well-marked pinnate parietal muscle. The acontia are not abundant.

No. 734, as stated above, differs in some respects from No. 712. Its base is not deeply concave as it is in No. 712, nor does it seem to have inclosed mud or sand for an anchor, but appears to have been adherent. The tubercles of the column are somewhat more distinct and rounded than in No. 712, and are all covered by cuticle. The sphincter has essentially the same structure as No. 712, but I did not dissect the specimen sufficiently to determine if the likeness extended to all the parts. I think, however, that there is little reason for disbelieving in the specific identity of the specimen with No. 712.

The specimens Nos. 733 and 735, obtained in the same dredging as No. 734, are both small, and white or pale brown in color, the cuticle being only very slightly developed. The base is only slightly concave and seems to have been adherent. The upper part of the column is marked by twenty-four longitudinal ridges, which show more or less distinct traces of transverse grooves, dividing each ridge more or less perfectly into a series of tubercles. I see no reason for supposing that these are other than young individuals of the same species as No. 734.

In changing the name of this species I have followed the suggestion made by Prof. Haddon ('89), and have named it after the distinguished naturalist who first described it. Verrill identified it with the *Actinia nodosa* of Fabricius, but the more recent observations of Haddon ('89) and Danielssen ('90) show that the two forms are quite distinct, and the former has assigned Fabricius' form to the genus *Chondractinia* proposed for it by Lütken ('60). This being the case, it seems advisable, for the avoidance of the confusion which might ensue from two so closely related forms possessing the same specific name, to change the name of Verrill's species.

28. Actinauge fastigata, nom. nov.

Plate XXXI, Figs. 93–97.

Synonym.—*Actinauge nodosa*, var. *coronata*, Verrill (1883).

No. 713. Station 2791. Lat. 38° 08′ S.; long. 73° 53′ W. Depth, 677 fathoms. Seven specimens.

It is customary, when a form originally described as a variety is advanced to the dignity of a species, to employ the varietal designation as the specific name. I have thought it well in the present case to depart from this precedent, since the specific term *coronata* has already been applied to a form belonging to the genus *Chitonactis*, which is nearly related to *Actinauge*.

The specimens of *Actinauge fastigata*, obtained by the *Albatross* from the same locality as most of the specimens of *A. Verrillii*, are in all respects similar to those described by Verrill ('83) from deep water off the St. George's Banks.

The specimens measure from 3.5 to 4.4^{cm} in height, with a diameter at the upper part of the column of from 2 to 2.5^{cm}.

The base is somewhat smaller than the column and, apparently, is adherent; one of the specimens clasps the tube of a *Hyalinœcia*. In none of the specimens is it deeply concave, inclosing mud or sand, as is the case with *A. Verrillii*. The limbus is smooth, and in nearly all the specimens is destitute of cuticle and is rather thin, allowing the insertions of the mesenteries to show through.

The column is cylindrical (Pl. XXXI, Fig. 93), gradually increasing in diameter towards the upper part, the capitulum being, however, completely infolded in all the specimens. The lower part of the column is covered with low and small warts, arranged, more or less distinctly, in

rows, and giving the column almost a granular appearance in some specimens. They become smaller as they approach the limbus, and fade out a short distance above it. A dark brown cuticle covers this portion of the column. Just below the capitulum, and forming therefore the summit of the contracted column, are two circles of very prominent tubercles, tipped with blunt chitinous points. There are twenty-four such tubercles, arranged in two horizontal rows of twelve each, so that there may be said to be twelve longitudinal rows of these large tubercles, each row consisting of two tubercles. Between each pair of longitudinal rows there is usually to be seen a row of small tubercles, so that there are in all twenty-four longitudinal rows of tubercles, twelve of them being very large and prominent, and twelve small and almost hidden by the larger ones. The capitulum is essentially the same as that of *A. Verrillii*, possessing forty-eight longitudinal ridges which run to the bases of the tentacles. It is destitute of cuticle and tubercles. The sphincter (Pl. XXXI, Fig. 94) resembles that of *A. Verrillii* closely. It is tolerably wide, but not thick, being only slightly thicker in its upper part than it is lower down. In section it appears as a number of more or less circular cavities, traversed by delicate partitions, which support the muscle cells. In the lower part (Pl. XXXI, Fig. 95) there is only one such cavity to the thickness of the muscle, but above (Pl. XXXI, Fig. 96) there may be three or four, or even more, since the cavities tend to become smaller in the upper part. Throughout its whole width the muscle is separated by a broad band of mesoglœa from the endodermal surface of the column, lying nearly midway between the two surfaces.

The tentacles are ninety-six in number, as calculated from the number counted in a sextant. They are decidedly entacmæous, and are arranged apparently in four cycles, it being difficult to distinguish those of the first two cycles by their position. Each tentacle possesses at its base a bulbous enlargement similar to that described for *A. Verrillii*. The longitudinal muscles of the tentacles are weak. The tentacles, disc, and stomatodæum seem to have been of a salmon or flesh-color.

The stomatodæum is provided with two rather shallow siphonoglyphes.

The mesenteries are arranged in three cycles, there being only twenty-four pairs in the specimen examined. Probably, however, a fourth cycle is present in larger specimens, since the number of tentacles would lead one to expect forty-eight pairs of mesenteries. The mesenteries of the first cycle are perfect and nongonophoric, those of the other two cycles being imperfect and at the same time gonophoric. The longitudinal musculature is well developed (Pl. XXXI, Fig. 97), there being a strong muscle pennon situated near the outer edge of the mesentery and having a somewhat abrupt inner edge, beyond which, however, are a number of much lower muscle processes gradually di-

minishing in size and finally disappearing a little internal to the mid-longitudinal line of the mesentery.

As stated above, Verrill originally described this form as a variety of *A. Verrillii*, stating that intermediate states between it and the normal form are not rare. The *Albatross* specimens do not show any such intermediate gradations, though both the presumed variety and the type species were obtained from the same locality. Leaving out of consideration the possibility of an approximation of the arrangement of the tubercles in the two forms, there are yet other characters which, it seems to me, are of sufficient importance to necessitate the separation of the two forms as distinct species. These may be briefly summed up as follows: (1) The proportion of the diameter to the height of the column in *A. fastigata* is considerably less than in *A. Verrillii*, the latter having consequently a much more robust form than the former; (2) the base in *A. fastigata* is adherent, while in *A. Verrillii* it is deeply concave and incloses a mass of mud or sand which serves as an anchor; (3) the relations of the nongonophoric and gonophoric mesenteries differs in the two forms; (4) the longitudinal musculature of *A. Verrillii* is weak, whereas in *A. fastigata* it is strong and forms a well-developed pennon.

Genus CHITONANTHUS, gen. nov.

Chondractininæ in which the capitulum is provided with longitudinal ridges; the scapus, especially in its upper portion, with strong pointed tubercles not arranged in any definite order, or else with a single circle of coronal tubercles; the cuticle strongly developed upon the tubercles; tentacles without any bulbous enlargement at the base.

I suggest this genus for two forms already described by Hertwig ('82, '88) as *Phellia pectinata* and *Phellia spinifera*. There can be no doubt that it is advisable to remove them from the genus *Phellia*, the typical members of which have a smooth capitulum. If the definitions which Haddon ('89) has proposed for the various genera of Chondractinidæ be accepted, Hertwig's *Phellia spinifera* finds no place among them. It comes close to *Chitonactis*, but differs in possessing ridges upon the capitulum. It is to be noticed that Haddon has assigned the form described by Hertwig ('82) as *Phellia pectinata* to the genus *Hormathia* of Gosse. If this be correct, *Phellia spinifera* must be referred to the same genus whose definition will require to be amended so as to include forms possessing tubercles scattered irregularly over the scapus. However, if the figure given by Gosse ('60) of his *Hormathia margaritæ* be correct, its capitulum is smooth and it would perhaps be as well, especially when we consider how little is definitely known regarding the type species of the genus, to reserve *Hormathia* for those forms in which the capitulum is smooth and which possess only a coronal row of tubercles, associating the *Phellia pectinata* of Hertwig and the *Hormathia andersoni* of Haddon ('88), which

possess only coronal tubercles but have a ridged capitulum with Hertwig's *Phellia spinifera* in the new genus *Chitonanthus*. It is of course a question as to whether the presence or absence of capitular ridges is worthy the importance which this arrangement gives it; but it must be recognized that the classification of the *Chondractininæ* is at present more a question of convenience in identification than of phylogenetic relationship, and that what may be trivial characters have been raised to the elevation of generic distinctions. Thus, to judge from Haddon's definitions of the genera, the principal feature which distinguishes *Chondractinia* from *Chitonactis* is that the tubercles in the latter are pointed, while they are mostly low and nodule-like in the former. (See appendix p. 209.)

29. Chitonanthus pectinatus (Hertwig).

Plate XXXII, Figs. 98–102.

Synonym: *Phellia pectinata* Hertwig (1882); *Phellia spinifera* Hertwig (1888).

No. 703. Station 2780. Lat. 53° 01′ S.; long. 73° 42′ 30″ W. Depth, 369 fathoms. Three specimens.

The three specimens which represent this species have a very different appearance from one another. One (Pl. XXXII, Fig. 98), which may be considered the most typical, is seated upon a detached valve of a Lamellibranch shell by a broad, flat disk. Its column was much contracted and thrown, to a certain extent, into folds. It measured 2.1^{cm} in height and 1.9^{cm} in diameter, and was covered with irregularly scattered tubercles which were low and flat near the base, but sharp and prominent above, where they become more numerous. The upper tubercles owe their sharpness to a strong development of cuticle over them, and it is possible that in the lower ones this cuticular point has been lost. Though scattered irregularly over the column for the most part, yet they show a tendency to arrange themselves above in twelve longitudinal rows.

The second specimen, the one which I chose for detailed study, is larger than the first, measuring 3.5^{cm} in height and 3^{cm} in breadth. Its base is broad and flat, like that of the first specimen, but had been detached from its support, only particles of a shelly nature being attached to it. The column is almost smooth and white in color, the brown cuticle, which covered the first specimen, having disappeared, except in the immediate neighborhood of the limbus. The general smoothness of the column is, however, relieved by a few nodule-like elevations (Pl. XXXII, Fig. 99), and some rarer, more prominent nodules tipped with brown cuticle. Toward the summit, however, one finds twelve strong ridges, each more or less broken into rows of tubercles and terminating above in a strong tubercle tipped with a prominent thickening of cuticle.

The third specimen measured 2^{cm} in height and 2.5^{cm} in breadth, and was seated upon the valve of a Lamellibranch shell. Like the second specimen it was white in color, only a few isolated patches of cuticle

persisting. It differs from both the others, however, in being utterly devoid of tubercles, the only indication of any such structures being the occurrence of about twelve ridges at the upper part of the column, which end abruptly at the junction of the capitulum and scapus, but are not tipped with a cuticular thickening.

The external appearance of these three forms is so dissimilar that one might suppose them to be distinct species. Their occurrence in the same locality, the similarity of their support, in each case a Lamellibranch shell, and the gradations which they show led me to believe that they were identical. I made a detailed study of only one, the second, and consequently can not speak as to the identity throughout of the internal structure, but so far as this could be examined by slitting the specimens longitudinally there was perfect similarity and I have little doubt but that all three ought to be assigned to the same species.

The infolded capitulum in all the specimens possesses twelve longitudinal ridges and, as in Hertwig's *Phellia pectinata*, the ridges towards their upper termination are divided by a longitudinal furrow which may be extensive enough to give the appearance of twenty-four ridges. In the first and second (Pl. XXXII, Fig. 99) specimens a few tipped tubercles are found on the infolded portion of the column, resting in the lower portion of the ridges, and each is more or less distinctly cleft into two parts. The strong sphincter (Pl. XXXII, Fig. 100) has the general appearance figured by Hertwig for *P. pectinata*. In its lower part it is thin and composed of cavities which are circular in section, but in its upper part (Pl. XXXII, Fig. 101) it thickens somewhat and the cavities are elongated in a direction perpendicular to the surface of the mesoglœa, some scattered round cavities occurring upon the outer surface of the muscle. I did not find in the mesoglœa of the column wall any of the concrements which Hertwig describes in *P. pectinata*. These seem to have been absent in his *P. spinifera* and are probably accidental foreign inclusions.

The tentacles (Pl. XXXII, Fig. 99, *t*) are rather short and slender and do not appear to have a bulbous enlargement at the base. They are arranged in about three cycles and appear to number forty-eight. The first two cycles correspond to the ridges of the capitulum, regarding each of these as really representing two, while the third cycle tentacles alternate with the ridges. The longitudinal muscles of the tentacles are fairly well developed and are not imbedded in mesoglœa. In color the tentacles seem to have resembled the disc, which was of a purplish brown color. Its radiating muscles present the peculiarity already described by Hertwig in *P. spinifera*.

The stomatodæum is long, reaching to below the middle of the internal cavity (Pl. XXXII, Fig. 99, *st.*), and is of the same purplish brown color which marked the tentacles and disc. The broad but shallow

siphonoglyphes are, however, not pigmented, and consequently are very noticeable when the animal is opened longitudinally.

There are four cycles of mesenteries, of which the primary cycle is alone perfect, and at the same time sterile; the fourth cycle mesenteries are small and are not gonophoric, the reproductive elements developing only in the mesenteries of the second and third cycles. The longitudinal musculature is well developed (Pl. XXXII, Fig. 102), but can hardly be termed "very strong." The pennon is not wide, the muscle processes arising in bunches from one to three stout elevations of the mesoglœa; it is much more marked in the upper portions of the mesenteries than it is lower down, where it becomes lower and at the same time broader. I did not observe any extensive folding of the transverse muscles, nor could I find in sections any parieto basilar muscle. Acontia are present, lying in bunches in the lower portion of the internal cavity.

I identify this form with Hertwig's *Phellia spinifera*, with which it agrees closely. I have, however, accepted the possibility which Hertwig suggests, that his *P. spinifera* may be a variety of his *P. pectinata*, described in his first report ('82). The dissimilarity in the arrangement of the tubercles in the two forms is to a certain extent, as he remarks, bridged over by the specimen obtained from station 320, and the second and third *Albatross* specimens help to bring the two forms into closer connection. If the difference in the nature of the disc musculature in the two forms holds throughout, it may be necessary to consider them distinct, but since in all other particulars they shade into each other so closely, I think it better to consider them for the present identical.

Genus **STEPHANACTIS**, Hertwig.

Chondractininæ in which the body is elongated in the transverse axis, the base inclosing a cylindrical body, such as an Alcyonarian stem; column with thick wall, but not covered by a well marked cuticle; capitulum smooth, separated from the smooth scapus by a well marked circular swelling.

In his report on the Actiniaria, obtained by the *Challenger*, Hertwig ('82) established a family Amphianthidæ for two genera *Amphianthus* and *Stephanactis*, both of which were characterized by the body being transversely elongated, the base clasping and inclosing the stem of a Gorgonia. From his observations on *Stephanactis tuberculata* he found that in the arrangement of the mesenteries, and in the presence of a sphincter muscle imbedded in the mesoglœa, there was a great similarity to a Sagartid, but he failed to discover acontia, although cinclidal openings pierced the column wall. Previously to Hertwig's discovery of these forms, von Koch ('78) had described an Actinian, adherent to and embracing by its base the stem of *Isis elongata*, and in this he fancied he had found a clue to the ancestry of the Antipatharia. This

form, which von Koch named *Gephyra dohrnii*, Haddon ('89) has investigated, and finds that "it belongs to the series of typical Sagartians." Danielssen ('90) again has described a form *Korenia margaritacea*, probably more correctly assignable to Hertwig's genus *Amphianthus*, concerning which he states that "the gastral filaments are richly beset with nematocysts," a remark which suggests the presence of acontia. He, however, finds that there are twenty-four perfect mesenteries, though acknowledging a possibility of error in this determination. Mention must be made also of Verrill's *Actinauge nexilis* ('83), a superficial examination of which leads one to the conclusion that it is a Chondractinian, though I have not been able as yet to detect the occurrence of acontia, the single specimen in my possession not being satisfactorily preserved, and consequently not suitable for accurate observation. A study of sections, which, unfortunately, I have not yet been able to make, may reveal these structures. Concerning this form I believe, too, that it is identical with *Stephanactis abyssicola* first described by Moseley ('77). It is undoubtedly a *Stephanactis*, and the superficial resemblance to Moseley's form is so close that, relying on the external characters, which are all in reality that we have to base a judgment upon, one would have little hesitation in pronouncing in favor of the specific identity of the two forms. Finally, *Chitonactis marioni* Haddon ('89) resembles *Stephanactis* in the elongation of the transverse(?) axis, and the clasping nature of the base, and is, *fide* Haddon, a Sagartian belonging to the subfamily Chondractininæ.

In view of this evidence, which it must be acknowledged is by no means conclusive, I think it is advisable to abolish the family Amphianthidæ and include *Stephanactis* and *Amphianthus* under the subfamily Chondractininæ. Furthermore, it seems not improbable that it may be necessary to disregard the clasping habit, and the consequent elongation of the body to the transverse axis as generic characters, since, as in the case of *Chitonactis marioni* these features may be assumed by species belonging to genera not characterized by them.

Independently, however, of these features depending on the habitat, the genus *Stephanactis* is sufficiently well marked out from other Chondractinidæ to warrant its retention.

30. Stephanactis hyalonematis, sp. nov.

Plate XXXII, Fig. 103.

No. 720. Station 2807. Lat. 0° 24′ S; long. 89° 06′ W. Depth, 812 fathoms. One specimen.

The single specimen I was unwilling to mutilate any more than was absolutely necessary, and consequently am unable to give an accurate description of its structure; nor can I even determine from it whether or not acontia are present.

The base clasped firmly a small bunch of Hyalonema fibres, the margins of the base coming into close contact, but still being separable by the use of a little force. The animal (Pl. XXXII, Fig. 103) is much elongated in the direction of the axis of the bunch of fibres to which it is attached, and is low. The column wall is remarkable on account of its brittleness. It is hard and brittle, like parchment, and is much wrinkled by contraction. In sections through a small piece of the wall no ectoderm or cuticle could be observed, but the mesoglœa was found to have been altered into a chitin-like substance, not taking the stain (borax-carmine) except on the outer and inner surfaces to a slight extent. A distinct thickened ring surrounds the upper part of the column separating the scapus from the capitulum. The latter has a slightly irregular surface, but is not tuberculate, and differs from the scapus in lacking the chitin-like induration of the mesoglœa. I could discover no trace of cinclides. A strong sphincter imbedded in the mesoglœa is present, but I can give no account of its shape in transverse sections. The tentacles are completely concealed, and my preparations do not throw any light upon the number or arrangement of the mesenteries.

Family BUNODIDÆ.

Actininæ with numerous perfect mesenteries, and with a strong, circumscribed endodermal sphincter. Column wall frequently provided with tubercles, verrucæ, etc.; margin frequently with complicated acrorhagi. No acontia.

Genus **LEIOTEALIA**, Hertwig.

Hertwig ('83) established this genus for a form which differed from all forms which had previously been assigned to the family Bunodidæ by lacking the tubercles or verrucæ which had been considered characteristic of the family. The internal arrangements of the *Challenger* specimen showed it, however, to be closley related to the verrucose forms, with which Hertwig very properly associated it, substituting for previous definitions of the family, which he named Tealidæ, a more accurate one founded upon an anatomical basis.

To the genus *Leiotealia* are to be referred Bunodidæ without verrucæ or acrorhagi, and perhaps to this may be added the pinnate arrangement of the muscle processes constituting the sphincter.

31. **Leiotealia badia**, sp. nov.

Plate XXXII, Fig. 104; Plate XXXIII, Fig. 106.

No. 702. Station 2779. Lat. 53° 06′ S.; long. 70° 40′ 30″ W. Depth, 77¼ fathoms. One specimen.

The base is firmly adherent to a large annelid tube. The column is contracted to a somewhat conical shape, and measures 2^{cm} in height with a diameter midway between the base and margin of 2.3^{cm}. It is

wrinkled transversely by contraction, and also is roughened by numerous small elevations, which, however, do not represent tubercles or verrucæ. The specimen is one of the few of the collection which have retained to a certain extent their coloration, the ectoderm of the column wall being of a dark brick-red color. A noticeable feature is the readiness with which the thick ectoderm separates from the mesoglœa in large pieces; an explanation of this is found in the peculiar structure of the lower layer of the ectoderm. The outer layer of the ectoderm contains a few small nematocysts and a large number of gland cells, some of which stain very deeply with carmine, while others hardly stain at all. Below these there is a granular layer which stains rather deeply, and next to the mesoglœa, occupying the region, where, in the tentacles, for instance, the nerve layer is found, is a broad, slightly stained, fibrillar layer, in which are numerous delicate spindle-shaped cells. It seems probable that this layer is more or less nervous in its nature, but whether it is to be regarded as entirely nervous can not be determined. It is in this layer that the rupture takes place, when portions of the ectoderm detach themselves, the structure of the layer being delicate and maceration of it easily brought about.

The region of the column immediately above (or internal to) the margin is much depressed, appearing to represent a distinct fosse, and at the bottom of the depression there is present a strong circumscribed endodermal sphincter (Pl. XXXII, Fig. 104). In section it resembles closely that which I have described ('89) for *Discosoma anemone*, consisting of a central axis from which processes arise, producing a more or less pinnate appearance.

There being only a single specimen of the form, I cut out only a small portion of it for the examination of the sphincter, a piece of the excised portion being cut transversely for a study of the musculature of the mesenteries. I can not accordingly give any facts as to the tentacles, disc, or stomatodæum, or even regarding the arrangement of the mesenteries. A few tentacles were cut in making sections of the sphincter, and it was evident from these that their longitudinal muscles were very weak.

The small portion which was sectioned for the purpose of ascertaining the nature of the musculature of the mesenteries contained representatives of three cycles of mesenteries. Two of these bore reproductive organs, while the third was sterile. Approximately the excised portion represented one-twelfth of the circumference, and it may be computed that there are at least twelve sterile (and perfect?) pairs of mesenteries and twenty-four pairs that are gonophoric (and imperfect). The mass of the mesenterial filaments is very great, but no acontia could be recognized. The musculature of the mesenteries is fairly strong, gradually increasing in thickness from near the parietal edge to about the middle of the mesentery, where it abruptly diminishes (Pl. XXIII, Fig. 106); the parieto-basilars (*pbm*) form distinct folds upon the surfaces

of the mesenteries, and numerous cavities are inclosed between the mesoglœa of the fold and that of the mesentery proper, as in *Actinostola callosa*.

Owing to the lack of more complete data with regard to this form, I at first hesitated to classify it. It seems, however, to belong to Hertwig's genus *Leiotealia*, though without some knowledge as to the arrangement of the tentacles, the correctness of this reference must remain uncertain; the probability seems to lie in favor of a cyclical arrangement of the tentacles. The form recalls somewhat that described by Verrill ('67) for Kagosima Bay, Japan, as *Urticina coccinea*, but the "few, slightly prominent, inconspicuous verrucæ" could not be detected.

Family PHYLLACTIDÆ.

Hexactiniæ with simple conical tentacles at some distance from the apparent margin; between them and the margin are low tentacular or foliose structures (fronds). Sphincter endodermal, more or less circumscribed, lying in the interval between the tentacles and the frondose or tentacular structures. From two to several cycles of mesenteries perfect.

I have elsewhere ('89*a*) discussed the question as to whether this family should be referred to the suborder Stichodactylinæ, as Andres ('83) has done, or placed in the suborder Actininæ, and have decided in favor of the latter position. Upon this view the fronds are to be regarded as differentiated acrorhagi.

Genus **OULACTIS**, M.-Edw.

Phyllactidæ in which the column is provided with longitudinal rows of verrucæ in its upper part; the fronds are foliose. Sphincter muscle more or less circumscribed.

32. **Oulactis californica**, sp. nov.

Plate XXXII, Fig. 105; Plate XXXIII, Figs. 107–108.

No. 741. Pichilingue Bay, Gulf of California. Two specimens.

The base is adherent and rather thin, allowing the insertions of the mesenteries to be seen through it. The column (Pl. XXXII, Fig. 105) is cylindrical, and in the alcoholic specimens shows no trace of color. The two specimens measure, respectively, 3^{cm} and 3.5^{cm} in height, with a diameter near the upper part of the column of 2^{cm} and near the base of 1.5^{cm}. Toward the upper part of the column are verrucæ arranged in forty-eight longitudinal rows, each row being composed of from eight to ten verrucæ. The upper portion bearing the fronds is not concealed. The fronds occupy the margin and extend inwards to the bases of the tentacles, which surround the mouth; they are foliose, apparently becoming thickly so toward their external extremity, and appear to be forty-eight in number, corresponding to the rows of verrucæ, but owing to

their close approximation in the preserved specimens their exact number could not be accurately determined. On the endodermal surface of the region which intervenes between the fronds and the tentacles is the sphincter, whose form may be better understood from the figure (Pl. XXXIII, Fig. 108) than from a verbal description. It will be seen that it approaches the circumscribed type, but still has a considerable attachment to the column wall. It may, however, be fairly termed circumscribed.

The tentacles are simple and few in number. They appear to be arranged in two cycles, there being six in each cycle, but it is difficult to make them out satisfactorily in the preserved specimens.

The stomatodæum is provided with longitudinal ridges supported on elevations of the mesoglœa. The siphonoglyphes are deep, with smooth walls, and with the mesoglœa much thickened. There are twenty-four pairs of mesenteries, twelve of them being perfect. The longitudinal muscles form a broad, well-defined muscle pennon (Pl. XXXIII, Fig. 107), and a well-developed parieto-basilar muscle is present. No reproductive elements could be discovered.

This form may have some relationship to the form described by Verrill ('68) as *Lophactis ornata*, as in that form the fronds are more foliose near their outer ends than toward the bases of the tentacles. They seem, however, to be more numerous, though, as stated above, it was difficult to decide upon the exact number, owing to their confusion with one another in the contracted preserved specimen; perhaps twenty-four would be more correct, each showing indications of a division into two toward the outer extremity and so giving the appearance of forty-eight. It seems probable that it is unnecessary to separate Verrill's genus *Lophactis* from *Oulactis*, though very decided differences exist between the present form and his *L. ornata*, with which one might be inclined to identify it.

Genus **CRADACTIS**, gen. nov.

Phyllactidæ with the fronds represented by bunches of simple or slightly branched, short, tentacle-like structures. Sphincter aggregated or circumscribed. Column with verrucæ.

Among the actiniæ which I described from the Bermuda Islands ('89*a*) was one which I referred to the genus *Oulactis* as *O. fasciculata*. I propose here to unite this form, which differs markedly from *Oulactis* in the structures of its fronds, with a form in the *Albatross* collection, in the above new genus. An objection to this may be found in the very different nature of the sphincters in the two species, that of the one being almost diffuse, while the other is typically circumscribed. The structure of the fronds has been a generic character hitherto for the Phyllactidæ, and it is convenient for the present to retain it as such. When the anatomy of a larger number of species is known, it can be determined whether a classification upon this basis can be retained.

33. Cradactis digitata, sp. nov.

Plate XXXIII, Figs. 109–112.

No. 692*a*. Station 2766. Lat. 36° 47′ S.; long. 56° 23′ W. Depth, 10½ fathoms. Three specimens, two of which, however, are small.

The three specimens of this species were contained in the same bottle which held the forms described above as *Sagartia paradoxa*.

The base of the single adult specimen was injured, so that it is impossible to say whether or not it was adherent originally. The column is cylindrical, and measures in the adult specimen 2^{cm} in height and 1.5^{cm} in diameter. The base is somewhat smaller than the column. Numerous, somewhat scattered, verrucæ occur on the column wall, being much more distinct near the apparent margin than lower down. The fronds consist of bunches of short, blunt, tentacle-like processes (Pl. XXXIII, Fig. 110), each of which divides, near its extremity, into two short arms. The endoderm of the fronds is colored with brown pigment. The sphincter (Pl. XXXIII, Fig. 111) is very strong and is circumscribed, resembling closely that form of sphincter which is characteristic of the Bunodidæ.

The tentacles are short and stout, and each has apparently a pore at the tip (Pl. XXXIII, Fig. 109*t*). They seem to be arranged in about two cycles, and are not numerous, probably not exceeding forty-eight. Their endoderm contains brownish pigment similar to that of the fronds.

The stomatodæum in all the specimens is considerably evaginated. It possesses two well-developed and deep siphonoglyphes, whose mesoglœa is decidedly thickened and smooth, that of the rest of the stomatodæum being raised into longitudinal ridges.

There are twenty-four pairs of mesenteries, twelve of which are perfect. The longitudinal muscles (Pl. XXXIII, Fig. 112) are well developed, forming a broad pennon, similar to that of *Oulactis californica;* the parieto-basilar muscle is also well developed, forming a fold upon the surface of the mesenteries. No reproductive organs were observed.

Order STICHODACTYLINÆ.

Hexactiniæ, in which the tentacles are arranged radially, more than one communicating with some or all of the endocœls.

Family CORALLIMORPHIDÆ.

Stichodactylinæ, with a marginal corona of tentacles, and intermediate tentacles similar to those of the margin arranged in radial series, each series consisting of from one to many tentacles. Musculature throughout weak; no specially developed sphincter.

This family was established by Hertwig ('82) for the reception of the two forms described by Moseley ('77) under the generic term

Corallimorphus. In the "Supplement" Hertwig ('88) added to this genus, as another member of the family, the genus *Corynactis.* Previous to this, however, Andres ('83) had defined the family Corynactidæ, splitting up Gosse's family Capneadæ, which he had previously accepted ('80*a*), though recognizing that it was not altogether natural, and agreed with Hertwig in incorporating in his new family the genera *Corynactis* and *Corallimorphus*, adding also the genus *Capnea.* The name proposed by Andres is preferable to that of Hertwig, both on account of the greater antiquity of the genus, which serves as its sponsor, as well as on account of Hertwig's name carrying with it a significance which might give rise to misunderstanding. Hertwig's name has, however, the priority in publication, and it is therefore proper to retain it.

Genus CORALLIMORPHUS, Moseley.

Corallimorphidæ, with capitate tentacles, there being only one intermediate tentacle in each radial series; some of the marginal tentacles have no intermediate tentacles corresponding to them.

34. Corallimorphus profundus Moseley (1877)

No. 731*b*. Station 2839. Lat. 33° 04′ N.; long. 118° 40′ W. Depth, 414 fathoms. Two specimens.

These two specimens I found in a bottle which contained also specimens of *Myonanthus ambiguus* and *Paractis vinosa.* Both were in a very poor state of preservation, so that I can add nothing to the anatomical description given by Hertwig ('82). One of the specimens was attached to a fragment of a gasteropod shell. The column measured 1^{cm} in height and the disk had a diameter of 2.5^{cm}. There were no indications of any tendency to infold the margin, and sections demonstrated the absence of any sphincter.

The marginal tentacles were forty-eight in number, twelve being decidedly larger than the other thirty-six, and there were twelve intermediate tentacles corresponding to the larger marginal ones. The capitate nature of the tentacles could be made out only with difficulty, but they certainly possessed that character. There appeared to be a slight thickening of the disc mesoglœa at the base of each of the intermediate tentacles.

Family DISCOSOMIDÆ.

Stichodactylinæ with tentacles of only one form, short and tentacular, and covering the greater portion of the disc. Sphincter muscle strong and circumscribed, not embedded in the mesoglœa.

Genus DISCOSOMA.

Discosomidæ in which the column is not covered with tubercles, though verrucæ may be present in the upper part. Tentacles short and fingerlike.

35. Discosoma fuegiensis (Dana) M.-Edw.

Plate XXXIV, Figs. 113 and 114.

Synonyms: *Actinia fuegiensis*, Dana (1846); *Discosoma fuegiensis*, Milne-Edwards (1857); *Sagastia fuegiensis*, Gosse (1860); *Cereus fuegiensis*, Verrill (1868).

No. 693. Station 2767. Lat. 40° 03′ S.; long. 58° 56′ W. Depth, 52 fathoms. Four specimens.

There is a certain amount of doubtfulness in this identification, since it is not possible to be certain as to whether the form described by Dana ('46) is really a *Discosoma*. Milne-Edwards ('57) considered it to be such, and Andres ('83) places it among the doubtful species of the same genus. So far as the description goes the *Albatross* specimens agree fairly well, and come from a station not especially remote from the locality in which Dana's form was found and from comparatively shallow water.

The four specimens differ considerably in size. The largest measures 2.5^{cm} in height, and 4.5^{cm} in diameter, while the smallest is 1^{cm} in height, with a diameter of 2.5^{cm} at the base. Three of the specimens are only partially contracted, the prominent lips of the mouth, and the outer cycles of tentacles being visible, while one of the smaller forms is completely contracted, the tentacles and mouth being entirely concealed, and the body having the form of a cone, sloping gradually upward from the flat base.

The base is adherent and has attached to it fragments of a brown cuticle. The mesoglœa is thin and in some specimens has been ruptured, allowing the mesenterial filaments to protude.

The ectoderm of the column has been macerated away for the most part, the few fragments that persist towards the limbus having a dingy white color in the preserved specimens, and presenting a reticulate appearance. The exposed mesoglœa has a cream-white color, and is smooth. In some of the specimens it has been considerably macerated, especially towards the upper part of the column, where the mesenteries are exposed. Owing to the absence of ectoderm, it is impossible to determine whether or not verrucæ may have been present in the upper part of the column. The sphincter muscle (Pl. XXXIV, Fig. 113) is strong and is of the circumscribed endodermal variety, resembling greatly that occurring in certain Bunodidæ.

The margin appears to have been lobed. The tentacles are numerous and short, and are arranged in radial series. Their ectoderm is very richly supplied with nematocysts. Their longitudinal musculature and the corresponding musculature of the disc is well developed, and is not imbedded in the mesoglœa.

The mouth is very prominent, and shows indistinct traces of a dark, slate-gray pigment. The mesoglœa of its lips is thickened, the thickening gradually thinning out, both towards the disc and towards the stomatodæum. This is marked with longitudinal ridges, supported by mesoglœal elevations, and possesses deep siphonoglyphes.

There are ninety-six pairs of mesenteries. Twelve of them, representing the first two cycles, are perfect, the rest imperfect, the fifth cycle of forty-eight pairs being very small, hardly projecting above the endoderm. Reproductive organs are borne upon the forty-eight mesenteries composing the third and fourth cycles. No acontia are present. The longitudinal muscles of the mesenteries (Pl. XXXIV, Fig. 114) have a moderate degree of development, forming a rather diffuse pennon. The parieto-basilar is, however, strong, forming a well-marked pouch upon the surface of the more developed mesenteries.

Very decided differences exist between this form and *D. anemone* previously studied by me ('89), but nevertheless a general similarity is well marked, showing itself in the shape and structure of the tentacles, the character of the sphincter muscle, and the deep siphonoglyphe. The musculature of the mesenteries has, however, a very different arrangement, and the relationship of the perfect and imperfect mesenteries is quite different. These points, however may be justly regarded as specific.

Tribe CERIANTHEÆ. Hert.

Anthozoa, with a large number of unpaired mesenteries, and with a single siphonoglyphe; the eight Edwardsian mesenteries are situated, four on each side, at the sulcar surface, and new mesenteries are added at the sulcular surface, being interposed, one on each side of the sagittal plane, between those immediately preceding them in time of formation. The base is not adherent and is usually provided with a pore opening into the body-cavity. Column walls, with strong ectodermal musculature.

Family CERIANTHIDÆ.

With the characters of the tribe.

Genus CERIANTHUS, Della Chiaje.

Whether the form described below be correctly referable to the genus *Cerianthus* is questionable, inasmuch as it seems to differ in several particulars from any of the forms hitherto referred to the genus. Andres ('83) divided the forms assignable to the family Cerianthidæ into three genera (not including *Arachnactis*), but the characters upon which these genera were based hardly seem at present of sufficient importance to be considered generic. It seems to me preferable, at present, to assign the specimen described below to Della Chiaje's genera rather than to establish a new genus on insufficiently understood characters.

36. Cerianthus vas, sp. nov.

Pl. xxxiv, Figs. 117-119; Pl. xxxv, Fig. 120.

No. 726. Station 2838. Lat. 28° 12′ N.; long. 115° 09′ W. Depth, 44 fathoms. One specimen.

The single Cerianthid which I found in the collection gave so much promise of interesting results that I determined to sacrifice it to an anatomical investigation. Unfortunately, however, it did not prove to be well preserved, and many points on which I had hoped to obtain definite information remained obscure, partly owing to the preservation and partly to the difficulties in the way of obtaining all the necessary data from a single specimen. A portion of the upper part I cut in longitudinal sections in the endeavor to obtain, if possible, definite information as to the absence of tentacles, and was thus prevented from making a thorough study of the arrangement of the mesenteries.

The specimen (Pl. xxxiv, Fig. 117) measured 2.0cm. in length and about 0.9cm. in diameter, and had a decided vase-like appearance. The margin was slightly reflected, and there was a distinct neck-like constriction a little below it. The column was cylindrical, tapering gradually below, where there was a large, widely open pore communicating with the interior cavity. The ectoderm had a pale brown color, and its musculature was richly developed in the manner characteristic of the Cerianthidæ.

No tube accompanied the specimen, nor have I any information as to whether there was one when it was found.

A remarkable peculiarity which attracted my attention at once was the apparent absence of tentacles. Neither at the margin nor upon the disc could any of these structures be found. It is possible that they may have fallen away, an idea to which the fact that any sections through the margin did not show continuity of the column wall and disc, except in one or two cases, gives support. It seems hardly possible, however, that if they had been present they could have disappeared so completely as they seem to have done, and I am rather inclined to believe that they were absent or reduced to mere rudiments.

The stomatodæum was narrow, extending only a short distance into the interior cavity. The portion which I used for longitudinal sections probably contained the siphonoglyphe. Upon the other side of the stomatodæum no siphonoglyphe occurred.

In a section through the middle of the column (Pl. xxxv, Fig. 120) twenty-two mesenteries could be counted. They showed a tendency to be arranged so that broad and narrow mesenteries should alternate with one another, but this arrangement was frequently marred by a broad mesentery occurring in the place of a narrow one, and vice versa. It is evident, however, that two grades of mesenteries are represented in the section, one consisting of about twelve mesenteries quite wide and bearing reproductive organs as a rule, and one whose mesenteries

were much narrower and were also destitute of reproductive organs. Whether, as I am inclined to believe is the case, a third grade is present, extending only a short distance below the stomatodæum, is uncertain. I was not able to prepare a satisfactory series of sections which would demonstrate this point, but sections made through a small portion of the column wall at a level with the stomatodæum seem to show a greater number of mesenteries than occur in a portion of the same size lower down.

The character of the mesenteries attached to the sulcar directive I did not discover. Opposite the sulcular end of the stomatodæum I found a single mesentery (Pl. XXXIV, Fig. 118, *mes*) which rapidly diminished in size as it passed backward, and even at the level of the lower edge of the stomatodæum was reduced to the merest rudiment. This I take to be a newly formed mesentery, its fellow of the opposite side not having appeared.

A decided abnormality was seen in sections taken about the middle of the column (Pl. XXXV, Fig. 120), which involved two mesenteries situated at or near the sulcar surface(*). These had united to form a band from which two lamellæ extended into the body cavity. A little higher these lamellæ were likewise united so that a cavity was inclosed by the united mesenteries.

I was not able to distinguish any acontia in the region where they usually occur in Cerianthids, though mesenterial filaments occurred on all the mesenteries. They were very imperfectly preserved, however, and did not allow of an accurate study.

The reproductive organs are borne by the widest mesenteries, which extend the greatest distance down the column. Both ova and spermatozoa seem to be borne by each mesentery. (Plate XXXV, Fig. 119, *ov* and *te*.) Ova are certainly present and occurring with them, inclosed in the mesoglœa, bodies which I take to be spermatozoa. They (*te*) vary much in size, occasionally being many times larger than the ova, and consist of a deeply staining wall crowded with small nuclei, a cavity occurring in the center of the larger ones and containing numerous nuclei, attached to which I could in some cases discover delicate appendages. They do not resemble the spermatozoa bundles of the Hexactiniæ, but bear a close resemblance to the testes of *C. membranaceus*, figured by the Hertwigs. *Cerianthus vas* is accordingly most probably one of the hermaphrodite Cerianthids.

The endoderm covering the mesenteries presents the same characters as that found in the same regions in *C. americanus*, which I have described elsewhere ('90).

UNIDENTIFIED FORMS.

No. 725. Station 2825. Lat. 24° 22′ 15″ N.; long. 110° 19′ 15″ W. Depth, 7 fathoms. One specimen.

No. 955. Station 2765. Lat. 36° 43′ S; long. 56° 23′ W. Depth, 11½ fathoms. One specimen.

Part III.

GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION OF THE ACTINIARIA.

To anyone who has studied the habits of Actinians the dependence of the various species upon their surroundings is very evident. Some are to be found only on rocky shores, others prefer sandy bottoms, while others again make their homes only in muddy flats. Some bury themselves in the sand or mud so that only the disk and tentacles protrude, others are to be found only on gasteropod shells inhabited by Hermit Crabs, while others again firmly clasp stems of Gorgonians. In other words, nearly every species has a more or less definite habitat.

Furthermore, as a rule the various species have a more or less definite distribution, so that it is possible to mark out more or less definite geographical regions characterized by their Actinian fauna. Thus the eastern coast of the United States presents three fairly well defined regions so far as the Actinian fauna is concerned. North of Cape Cod we have what may be termed the Boreal region, characterized by the occurrence, among other forms, of *Tealia crassicornis*, *Metridium marginatum*, and *Cerianthus borealis* Verr. Secondly, there is what Verrill has called the Virginian region, which includes the Virginian and Carolinian coasts, and probably Georgia to the south, and Delaware and part of New Jersey to the north, characterized by the presence of *Phymactis cavernata*, *Adamsia sol*, and *Cerianthus americanus* among others; and lastly, there is the Florida region, characterized by forms identical with those of the West Indies. Northern New Jersey and Long Island Sound constitute an intermediate region possessing forms such as *Metridium marginatum*, reaching their most perfect development in the Boreal region, and others, such as *Eloactis* (*Halcampa*) *producta* and *Paractis rapiformis*, which belong properly to the Virginian region.

When the distribution of genera is considered, however, this definiteness, as might be expected, becomes more or less indistinct, though even with some of these distinct areas of delimitation can be established. With the larger groups the same holds true, and even when the orders are considered a certain amount of limitation of their distribution can be determined. The Actininæ, it is true, have a world-wide distribution, but, as I have pointed out ('89), the Stichodactylinæ, though of wide distribution, have their headquarters in the Pacific and West Indian regions, and it may be said in the regions of coral formation.

Our knowledge, however, of the Actinian fauna of a great deal of the Pacific and Indian Oceans and of the South Atlantic is as yet very slight, and it is hardly time to enter into an exhaustive discussion of the geographical distribution of the larger groups, families, and orders of the Actinaria. So far as the *Albatross* collection is concerned, there

is only one point that deserves special mention in this connection, and that is the very wide distribution which it reveals for certain deep-sea species.

Actinauge verrillii and *Actinauge fastigata* have been obtained by the U. S. Fish Commission at various localities off the eastern coast of the United States. The former is recorded from various stations from off the coast of Nova Scotia in the north to off Cape Hatteras in the south, from depths ranging from 30 to 506 fathoms. *A. fastigata* has been recorded from off Martha's Vineyard from a depth of 300 to 980 fathoms. In the *Albatross* collection these forms were obtained from the following stations:

A. verrillii: Stations 2791, 2818, and 2839.

A. fastigata: Station 2791.

Station 2791 was off the coast of Chile; station 2818 off the coast of Ecuador, in the neighborhood of the Galapagos Islands; and station 2839 off the coast of California.

Another form, *Actinostola callosa*, has likewise been obtained at various stations on the eastern coast, ranging from the Grand Banks of Newfoundland on the north to Cape Fear, N. C., on the south, at depths varying from 50 to 640 fathoms. This form likewise occurs upon the west coast of America, having been obtained by the *Albatross* at stations 2792, 2807, and 2818, all of which are off the coast of Ecuador, and vary in depth from 392 to 812 fathoms.

Since we have seen that species of Actiniæ are to a great extent dependent upon external conditions, this wide distribution of these deep-sea species is interesting. It seems improbable that they are wanting in the deep water of the southwestern Atlantic; or, in other words, that they occur sporadically upon the east and west coasts of America. Future observations will probably reveal their occurrence off the east coast of South America, a portion of the ocean whose Actinian fauna is still to be studied, and it seems probable that they occur over the sea bottom of the western trough of the Atlantic throughout its entire extent, and doubling Cape Horn extend up the west coast in deep water as far north at least as California. Since we know that the temperature at considerable depths is fairly constant and low, it may be supposed that over this wide area these forms find conditions sufficiently similar, and have thus been enabled to extend their distribution.

I give here in tabular form the localities and depths at which the various species of the *Albatross* collection were obtained:

No.	Name of species.	Station.	Latitude.	Longitude.	Depth.
	Tribe Edwardsiæ:		° ′ ″	° ′ ″	*Fathoms*
1	*Edwardsia intermedia*	2783	51 02 30 S.	74 08 30 W.	122
	Tribe Protactiniæ:				
2	*Oractis Diomedeæ*	2839	33 08 00 N.	118 40 00 W.	414
	Tribe Hexactiniæ.				
	Order Actininæ.				
	Family Halcampidæ:				
3	*Halcurias pilatus*	2785	48 09 00 S.	74 36 00 W.	449
4	*Peachia Koreni*	2764	36 42 00 S.	56 23 00 W.	11½
	Family Antheadæ:				
5	Actinia infecunda	....	Abrolhos Islands.		
6	*Anemonia variabilis*	2768	42 24 00 S.	61 38 30 W.	43
7	*Anemonia (?) inequalis*	....	Pichilinguo Bay.		
8	Condylactis cruentata	....	Straits of Magellan.		
9	*Myonanthus ambiguus*	2839	33 08 00 N.	118 40 00 W.	414
	Family Boloceridæ:				
10	*Bolocera occidua*	2783	51 02 30 S.	74 08 30 W.	122
	Bolocera occidua	2779	53 06 00 S.	70 40 36 W.	77½
	Bolocera occidua	2771	51 34 00 S.	63 00 00 W.	50½
11	*Bolocera pannosa*	2839	33 08 00	118 40 00 W.	414
12	*Bolocera brevicornis*	2839	33 08 00	118 40 00 W.	414
	Family Paractidæ:				
13	Paractis lineolata	2804	8 16 30 N.	79 39 45 W.	47
14	*Paractis vinosa*	2839	33 08 00 N.	118 40 00 W.	414
15	Antholoba reticulata	....	Port Otway, Patagonia.		
	Antholoba reticulata	....	Lota, Chile.		
	Antholoba reticulata	....	Galapagos Islands.		
16	*Actinernus plebejus*	2791	38 08 00 S.	75 53 00 W.	677
17	Actinostola callosa	2792	0 37 00 S.	81 00 00 W.	401
	Actinostola callosa	2807	0 24 00 S.	87 06 00 W.	812
	Actinostola callosa	2818	0 29 00 S.	89 54 30 W.	392
18	*Actinostola excelsa*	2770	48 37 00 S.	65 46 00 W.	58
	Actinostola excelsa	2771	51 34 00 S.	68 00 00 W.	50½
19	*Actinostola pergamentacea*	2769	45 22 00 S.	64 20 00 W.	51½
20	*Pycnanthus maliformis*	2839	33 08 00 N.	118 40 00 W.	414
21	*Cymbactis fæculenta*	2839	33 08 00 N.	118 40 00 W.	414
	Family Sagartidæ:				
22	*Sagartia lactea*	2785	48 09 00 S.	74 36 00 W.	449
23	*Sagartia Sancti Mathæi*	2764	36 42 00 S.	56 23 00 W.	11½
24	*Sagartia paradoxa*	2766	36 47 00 S.	56 23 00 W.	10½
25	Sagartia crispata	2799	8 44 00 N.	79 09 00 W.	29½
26	*Adamsia (?) involvens*	2793	1 03 00 N.	80 15 00 W.	741
27	Actinauge Verrillii	2791	38 08 00 S.	75 53 00 W.	677
	Actinauge Verrillii	2839	33 08 00 N.	118 40 00 W.	414
	Actinauge Verrillii	2818	0 29 00 S.	89 54 30 W.	392
28	Actinauge fastigata	2791	38 08 00 S.	75 53 00 W.	677
29	Chitonanthus pectinatus	2780	53 01 00 S.	73 42 30 W.	369
30	*Stephanactis hyalonematis*	2807	0 24 00 S.	89 06 00 W.	812
	Family Bunodidæ:				
31	*Leiotealia badia*	2779	53 06 00 S.	70 49 30 W.	77½
	Family Phyllactidæ:				
32	*Oulactis californica*	....	Pichilingue Bay.		
33	*Cradactis digitata*	2766	36 47 00 S.	56 23 00 W.	10½
	Order Stichodactylinæ:				
	Family Corallimorphidæ:				
34	Corallimorphus profundus	2839	33 08 00 N.	118 40 00 W.	414
	Family Discosomidæ:				
35	Discosoma fuegiensis	2767	40 03 00 S.	58 56 00 W.	52
	Tribe Ceriantheæ:				
36	*Cerianthus vas*	2838	28 12 00 N.	115 09 00 W.	44

NOTE.—The species in *italics* are described for the first time in this report.

Hertwig ('82), as the result of his investigation of the *Challenger* Actiniaria, drew attention to two features presented by some deep-sea forms which marked them out from those living in shallower water, namely the retrogression of the tentacles to stomidia and the unusual arrangement of the mesenteries. The *Albatross* collection seems to lessen somewhat the importance of the first of these peculiarities by suggesting the propriety of doing away with the genera *Polysiphonia* and *Liponema*, but the second characteristic receives some support in

the discovery of *Oractis*, although the *Paractiniæ* have been removed from their high place. Two out of three of the genera forming the Tribe Protactiniæ are deep-sea forms, including under this head all those which live at depths approaching 500 fathoms.

It is doubtful, however, if any such limitation can be set to distinguish deep-sea for shallow-water forms. What we mean by deep-sea forms are forms which live under conditions as a rule only to be found in the deeper water, one of the most important of which is perhaps great and constant cold. This is a condition which may be obtained at various depths according to latitude, and it is quite possible, in fact it does happen, that forms which in more southern latitudes are found at 300 to 500 fathoms, may, in higher latitudes, occur at a depth of 30 to 50 fathoms. If, however, a limit is to be given I should suggest one much less than that proposed by Prof. Hertwig, perhaps as little as 100 fathoms. It would be better probably to allow the limit to vary, considering the zone at which the conditions are practically constant throughout the year to be the limit of true deep sea forms.

There is definite evidence of a wide bathymetrical distribution of deep-sea forms. For instance, *Corallimorphus profundus* was obtained by the *Challenger* from 1,375 to 2,025 fathoms, while the *Albatross* specimens were obtained from a depth of only 414 fathoms. So, too, we have seen that *Actinostola callosa* ranges from 50 to 812 fathoms, *Actinauge fastigata* from 300 to 980, and *A. Verrillii* from 30 to 677. Conversely also shallow water forms may extend down to depths sufficient to overlap the regions inhabited by what may be considered deep-water forms. For instance, *Antholoba reticulata* is typically a littoral form, yet the *Challenger* obtained it from a depth of 55 fathoms, a depth greater than the highest limit from which either *Actinostola callosa* or *Actinauge Verrillii* has been dredged.

Making allowance for such cases, however, it is not difficult to divide the Actiniaria into such forms as are typically deep-sea dwellers and those which inhabit shallower waters. Reviewing the various families as to their peculiarities in this respect, it will be found that certain groups may be assigned to one or other category, while others have representatives in both. Among these latter are the Edwardsiæ, Protactiniæ, Sagartidæ, Paractidæ and Corallimorphidæ; among the Sagartidæ the Sagartinæ are principally shallow-water forms, though some such as *Sagartia lactea* and *Adamsia* (?) *involvens* occur in deep water, while the Chondractininæ are essentially deep-water forms, though *Phellia* has several species dwelling in the littoral zone. The Paractidæ, too, though containing littoral forms are apparently more abundantly represented in deep water, and it is interesting to notice that in these as well as in the Chondractininæ, the deep-water forms are characterized by the thickness and firmness of the mesoglœa of the column walls. The Boloceridæ so far as known are deep-water forms, as are also the genera *Polystomidium*, *Polyopis*, and *Sicyonis;* and, on the other hand, the Antheadæ, Bunodidæ, Phyllactidæ, Heteractidæ, Thalassianthidæ, and

in fact all the forms with abnormally-shaped tentacles, excluding those in which these structures are reduced to stomidia, are essentially inhabitants of shallow water. Perhaps an explanation of the development of fronds as in the Phyllactidæ and of branching and nodulose tentacles in shallow-water forms may be found in the greater or less mimicry of the plant forms, with which littoral actinians are associated, which is thus produced, and which would serve as a protection from carnivorous enemies.

As with the geographical distribution, however, much yet remains to be done before any proper generalizations as to the significance of and the causes which govern the bathymetrical distribution of the Actiniaria can be made, and the remarks here presented are simply a sketchy outline of some of the ideas that have suggested themselves during the investigation of the *Albatross* collection.

MAY, 1892.

APPENDIX.

Since the preceding report was completed I have had the opportunity of examining the collections of Actinians in the museum at Berlin, and also the *Challenger* collection in the Natural History Department of the British Museum, and must express my sincere thanks at this earliest opportunity to Prof. von Martens and Prof. Jeffrey Bell for the courtesy with which they acceded to my request to examine these very valuable collections and for their great kindness in affording me every facility for studying them. I also desire to state my obligations to my friend Prof. A. C. Haddon for many valuable suggestions and much interesting information with regard to the European *Chondractininæ*, as well as for the opportunity of examining the valuable collection of forms belonging to that group which he possesses.

As the result of my studies of these collections I have been able to confirm the correctness of certain suggestions made in the report, and also have obtained new light upon the identification of certain forms, and have thought it advisable to incorporate in this Report in the form of an appendix some of the more important of my results.

Anemonia variabilis (p. 147).—In the Berlin Museum are preserved the forms described by Studer ('78), which were collected by the *Gazelle* expedition, and among them is a form which seems to be identical with that described above as *Anemonia variabilis*. This is *Corynactis carnea*, Studer. In size and habitat it agrees very closely with the *Albatross* specimens, and the capitate character which Studer describes for the tentacles is not at all well pronounced. It was upon this character that Studer relied in assigning it to the genus *Corynactis*, but the tentacles are plainly arranged in cycles, a fact which may be deduced from his statement that the tentacles are "zahlreich in zwei Reihen." The similarity is so striking that, taking it into consideration with the fact that both have the same habit, and come from essentially the same locality and depth, I have no hesitation in pronouncing for its identity

with the *Albatross* specimens, whose name should consequently be changed to *Anemonia carnea* (Studer).

Bolocera brevicornis (p. 158).—In the Report I have expressed my opinion that Hertwig's *Liponema multiporum* is a *Bolocera* from which all the tentacles have fallen away. After an examination of the *Challenger* specimens I feel more than ever convinced that such is the case. It is, however, as I suspected, specifically distinct from *B. brevicornis*.

Genus *Actinernus* (p. 165).—There can be no doubt but that Hertwig's *Polysiphonia tuberosa* properly belongs to the genus *Actinernus*, though its specific distinctness from all forms of that genus hitherto described is exceedingly probable.

It is interesting to note in connection with the extension of the geographical range of the genus from the western basin of the Atlantic to the Pacific that Haddon* has recently noted its occurrence in the eastern portion of the Atlantic, in 750 fathoms off the southwest coast of Ireland.

Actinostola callosa (p. 167).—Hertwig's *Dysactis crassicornis* is undoubtedly identical with this form. The description given by Verrill of *Urticina callosa* was published in '82, and Hertwig's report of the *Challenger* Actiniaria appeared in the same year, as did also a preliminary report.† It consequently is a question as to which name has the priority. There can be no question as to validity of Verrill's generic term, and it seems probable that his original description, which appeared in the March–April number of Silliman's American Journal of Science, slightly antedates Hertwig's preliminary report. Leaving this aside, however, it seems preferable to adopt Verrill's name in its entirety, since the term *crassicornis* has a prior association with a member of the genus *Tealia*.

Genus *Chitonanthus* (p. 189).—In establishing this genus I have laid stress upon two features: the presence of capitular ridges and the absence of bulbous enlargements at the bases of the tentacles. The unsatisfactory nature of the classification of the Chondractininæ alluded to above is principally due to the importance bestowed upon the nature and arrangement of the tubercles. The specimens of *Chitonanthus pectinatus* in the *Albatross* show of how little importance this feature may be in some cases, and it seems advisable to seek for some more constant characters. It is possible that these are to be found in the nature of the capitulum and of the bases of the tentacles. The genus *Actinauge* seems well marked off, but this is not the case with *Chondractinia*, *Chitonactis*, and *Hormathia*, genera established principally on the nature of the tubercles, or on their arrangement. It is not improbable that it will prove necessary to fuse these genera into one, removing from it, however, Hertwig's *Chitonanthus* (*Phellia*) *pectinatus* and Haddon's

* A. C. Haddon.—Report on the Actiniæ dredged off the southwest coast of Ireland in May, 1888. Proc. Roy. Irish Acad., 3d ser., Vol. I, 1890.

†Sitzungsber. Jenaisch. Gesellsch, 1882.

Hormathia Andersoni, both of which have been referred by the latter author to the genus *Hormathia*.

The Chondractininæ, if this suggestion prove worthy of acceptance, would then consist of the genus *Hormathia* characterized by the presence of tubercles and a smooth capitulum, and by the absence of bulbous enlargements at the bases of the tentacles; the genus *Actinauge* possessing tubercles, a ridged capitulum, and bulbous enlargements to the tentacles; *Chitonanthus* with tubercles, and capitular ridges, but without tentacular bulbs; and *Stephanactis*, if it prove to be a "good" genus, without tubercles, capitular ridges, or tentacular bulbs, but with a clasping base. To these it may be necessary to add *Phellia* without tubercles, capitular ridges, or tentacular bulbs and without a clasping base.

NOVEMBER 8, 1892.

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EXPLANATION OF PLATES.

ac = acontia.
bm = basal muscle.
cap = capitulum.
col = column wall.
cor = coronal tubercle.
cr = capitular ridges.
cu = cuticle.
D = directive mesenteries.
d = disc.
ec = ectoderm.
en = endoderm.
f = foreign incrustations on the column wall.
lm = longitudinal muscles.
m = muscles.
mes = mesentery.
mf = muscle fibres.
mg = mesoglœa.
nem = nematocysts.
ov = ova.
pbm = parieto-basilar muscle.
sph = sphincter muscle.
st = stomatodæum.
t = tentacle.
te = testis.
tm = transverse muscles.
tsp = sphincter of tentacle.
tu = tubercle.

PLATE XIX.

Fig. 1. *Edwardsia intermedia.* Nat. size.
2. Transverse section through introverted scapus of *E. intermedia.* Zeiss A 2.
3. Transverse section through mesentery of *E. intermedia.* Zeiss A 2.
4. Transverse section of column wall of *E. intermedia,* passing through a tubercle. Zeiss D 2.
5. *Oractis diomedeæ,* viewed from the side. Nat. size.
6. *Oractis diomedeæ,* viewed from above. Nat. size.
7. Transverse section of tentacle of *O. diomedeæ* near its base. Zeiss A 2.
8. Transverse section of column of *O. diomedeæ.* The roman numerals indicate the probable embryological succession of the mesenteries. (An error has been made in the reproduction of this figure. The mesentery numbered V should be I, and the imperfect mesentery intervening between this and III should be V.)

PLATE XX.

Fig. 9. Transverse section of a perfect mesentery of *O. diomedeæ.* Zeiss a 2.
10. Transverse section cutting column wall, disc and base of the tentacles of *O. diomedeæ.* Zeiss A 2.
11. Longitudinal section through margin and upper part of the column wall of *O. diomedeæ.* Zeiss a 2.
12. *Halcurias pilatus.* Nat. size.
13. Transverse section through mesentery of *H. pilatus.* Zeiss A 2.

PLATE XXI.

Fig. 14. Transverse section through the upper part of the column of *H. pilatus.* a 2.
15. Transverse section through ectoderm of the column wall of *H. pilatus.* Zeiss D 2.
16. *Peachia Koreni.* Nat. size.
17. Transverse section through a mesenterial filament of *Actinia infecunda.* Zeiss D 2.
18. *Anemonia variabilis.* Nat. size.
19. Transverse section through the column of *A. variabilis.* *x* and *y* denote areas where the regular sequence of perfect and imperfect mesenteries is interfered with. x about 10.
20. *Condylactis cruentata.* Nat. size.
21. Transverse section of primary mesentery of *Condylactis cruentata.* Zeiss a 2.
22. *Myonanthus ambiguus.* Nat. size.

PLATE XXII.

Fig. 23. Transverse section of sphincter muscle of *M. ambiguus.*
24. Transverse section of sphincter muscle of *Bolocera occidua.* Zeiss a 2.
25. Portion of transverse section of primary mesentery of *B. occidua.* Zeiss A 2.
26. Portion of transverse section of a tentacle of *B. occidua.* Zeiss a 2.
27. Basal portion of longitudinal section through a tentacle of *B. occidua.* Zeiss A 2 unscrewed.
28. Portion of transverse section of a tentacle of *B. pannosa.* Zeiss A 2.
29. Transverse section through a perfect mesentery of *B. pannosa.* Zeiss A 2.

PLATE XXIII.

Fig. 30. Transverse section of the sphincter muscle of *B. pannosa.* Zeiss A 2.
31. Transverse section of the sphincter muscle of *B. brevicornis.* Zeiss a 2.
32. Outer portion of transverse section of mesentery of *B. brevicornis.* Zeiss A 2.

Fig. 33. Inner portion of transverse section of mesentery of *B. brevicornis.* Zeiss A 2.
34. *Paractis lineolata.* Nat. size.
35. Transverse section of imperfect mesentery of *Paractis lineolata.* Zeiss a 2.
36. Transverse section of sphincter muscle of *P. lineolata.* Zeiss a 2.
37. *Paractis vinosa.* Nat. size.
38. Transverse section of tentacle of *P. vinosa.* Zeiss A. 2.
39. Portion of transverse section of mesentery of *P. vinosa.* Zeiss A 2.
40. Portion of transverse section of sphincter muscle of *P. vinosa.* Zeiss D 2

PLATE XXIV.

Fig. 41. Transverse section of sphincter of *P. vinosa.* Zeiss a 2.
42. Transverse section (somewhat oblique) of base of a tentacle of *Actinernus plebeius.* Zeiss A 2.
43. Portion of transverse section of sphincter muscle of *A. plebeius.* Zeiss A 2.
44. Portion of transverse section of primary mesentery of *A. plebeius.* Zeiss A 2.
45. Transverse section of mesentery of *A. plebeius.* Zeiss a 2.
46. Section, partly diagrammatic, showing the arrangement of the mesenteries of *Actinostola callosa.*

PLATE XXV.

Fig. 47. *Actinostola callosa.* Nat. size.
48. Transverse section of a tentacle of *A. callosa.* Zeiss A 2.
49 and 50. Transverse section of a perfect mesentery of *A. callosa.* Zeiss A 2.
51. Transverse section of sphincter muscle of *A. callosa.* x 2.
52. Portion of transverse section of sphincter muscle of *A. callosa.* Zeiss A 2.

PLATE XXVI.

Fig. 53. *Actinostola excelsa.* Nat. size.
54. Transverse section of sphincter muscle of *A. excelsa.* Zeiss a 2.
55. Transverse section of perfect mesentery of *A. excelsa.* Zeiss a 2.
56. Transverse section of portion of a tentacle of *A. excelsa.* Zeiss a 2.
57. *Actinostola pergamentacea.* Nat. size.
58. Tangential section of portion of the disk of a specimen of *Actinostola pergamentacea.* Zeiss A 2.

PLATE XXVII.

Fig. 59. Transverse section of sphincter muscle of *A. pergamentacea.* Zeiss a 2.
60. Portion of transverse section of a tentacle of *A. pergamentacea.* Zeiss A 2.
61. Portion of transverse section of mesentery of *A. pergamentacea.* Zeiss D 2.
62. Outer portion of transverse section of mesentery of *A. pergamentacea* above the level of the parieto-basilar muscle. Zeiss a 2.
63. Middle portion of same section as that from which Fig. 4 was drawn.
64. *Pycnanthus maliformis.* Nat. size.
65. Transverse section of sphincter muscle of *P. maliformis.* x 4.
66. Portion of transverse section of sphincter muscle of *P. maliformis* from the region indicated in Fig. 65. Zeiss D 2.
67. Transverse section through a perfect mesentery of *P. maliformis.* Zeiss a 2.

PLATE XXVIII.

Fig. 68. Tangential section through disk of a specimen of *P. maliformis.* Zeiss A 2.
69. *Cymbactis fæculenta.* Nat. size.
70. Transverse section of sphincter muscle of *C. fæculenta.* Zeiss a 2.
71. Transverse section of mesentery of first cycle of *C. fæculenta.* Zeiss a 2.
72. *Sagartia lactea.* Nat. size.

Fig. 73. Transverse section of sphincter muscle of *S. lactea.* x about 2.
74. Transverse section of of primary mesentery of *S. lactea.* Zeiss a 2.
75. Transverse section of acontium of *S. lactea.* Zeiss D 2.

PLATE XXIX.

Fig. 76. Portion of transverse section of sphincter muscle of *S. lactea.* Zeiss A 2.
77. *Sagartia Sancti Mathæi.* Nat. size.
78. Transverse section of sphincter of *S. Sancti Mathæi.* Zeiss A 2.
79. *Sagartia paradoxa.* Nat. size.
80. Transverse section of sphincter muscle of *S. paradoxa.* Zeiss A 2.
81. Transverse section of a directive mesentery of *S. paradoxa.*
82 and 83. *Adamsia? involvens.* Nat. size.

PLATE XXX.

Fig. 84. Semidiagrammatic section through the column of *S. paradoxa*, showing the arrangement of the mesenteries. The roman numerals indicate the cycles of mesenteries, x and y the abnormal pairs.
85. Transverse section of sphincter muscle of *A. involvens.*
86. Transverse section of sphincter muscle of *Actinauge Verrillii.* Zeiss A 2.
87. Transverse section through the upper third of the sphincter muscle of *A. Verrillii.* Zeiss A 2.
88. Transverse section through the lower third of the sphincter muscle of *A. Verrillii.* Zeiss A 2.
89. Portion of upper part of column of *A. Verrillii,* the specimen having been divided longitudinally. Nat. size.

PLATE XXXI.

Fig. 90. Transverse section of mesentery of the second cycle of *A. Verrillii.* Zeiss A 2.
91. Transverse section through the base of a tentacle of *A. Verrillii.* Zein A 2.
92. Outer portion of transverse section of a mesentery of the first cycle of *A. Verrillii.* Zeiss A 2.
93. *Actinauge fastigata.* Nat. size.
94. Transverse section of the sphincter muscle of *A. fastigata.*
95. Transverse section of the lower part of the sphincter muscle of *A. fastigata.* Zeiss A 2.
96. Transverse section of the upper part of the sphincter muscle of *A. fastigata.* Zeiss A 2.
97. Transverse section of a mesentery of the first cycle of *A. fastigata.* Zeiss A 2.

PLATE XXXII.

Fig. 98. *Chitonanthus pectinatus.* Nat. size.
99. View of surface of a dissected specimen of *C. pectinatus* which had been divided longitudinally. Nat. size.
100. Transverse section of the sphincter muscle of *C. pectinatus.* x 4.
101. Transverse section of portion of the sphincter muscle of *C. pectinatus.* Zeiss a 2.
102. Transverse section of a mesentery of the first cycle of *C. pectinatus.* Zeiss a 2.
103. *Stephanactis hyalonematis.* Nat. size.
104. Transverse section of sphincter muscle of *Leiotealia badia.* Zeiss A 2.
105. *Oulactis californica.* Nat. size.

PLATE XXXIII.

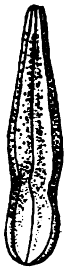
Fig. 106. Transverse section of primary mesentery of *L. badia.* Zeiss A 2.
107. Transverse section of a mesentery of the first cycle of *O. californica.*
108. Transverse section of sphincter muscle of *O. californica.* Zeiss A 2.
109. Portion of margin of *Cradactis digitata,* showing the tentacles and the fronds. x 2.
110. View of frond of *C. digitata.* Enlarged.
111. Transverse section of sphincter muscle of *C. digitata.* Zeiss A 2.
112. Transverse section of directive mesentery of *C. digitata.* Zeiss a 2.

PLATE XXXIV.

Fig. 113. Transverse section of sphincter muscle of *Discosoma fuegiensis.* Zeiss a 2.
114. Transverse section of the mesentery of the second cycle of *Discosoma fuegiensis.* Zeiss a 2.
115. Transverse section of sphincter muscle of *Anemonia? inequalis.* Zeiss a 2.
116. Transverse section of a portion of the column of *A. inequalis.* Zeiss a 2.
117. *Cerianthus vas.* Nat. size.
118. Dorsal portion of transverse section of the upper part of the column of *C. vas.* Zeiss a 2.
119. Transverse section through gonophoric region of a mesentery of *C. vas* Zeiss D 2.

PLATE XXXV.

Fig. 120. Transverse section through the middle of the column of *C. vas.* * points to the fusion of two mesenteries.
121. Diagram showing the relation of the tentacles to the capitular ridges in *Actinauge Verrillii.*



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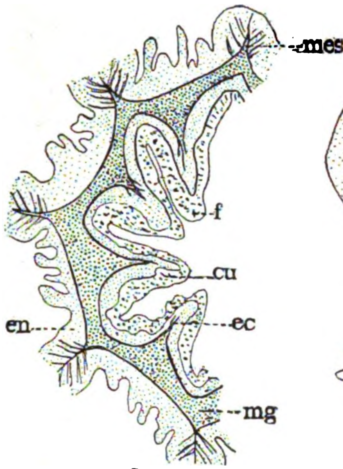

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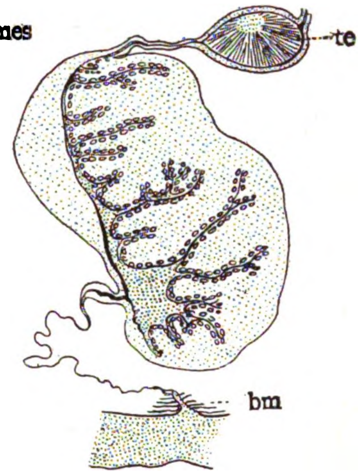

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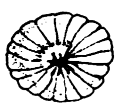

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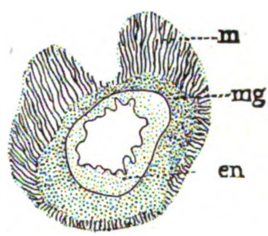

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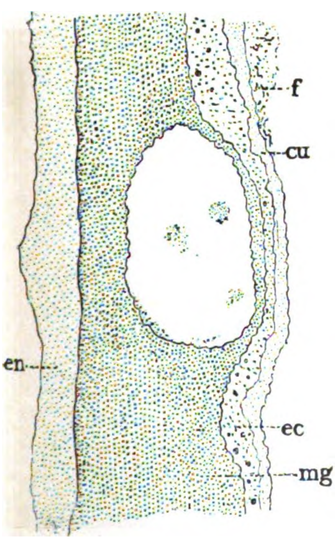

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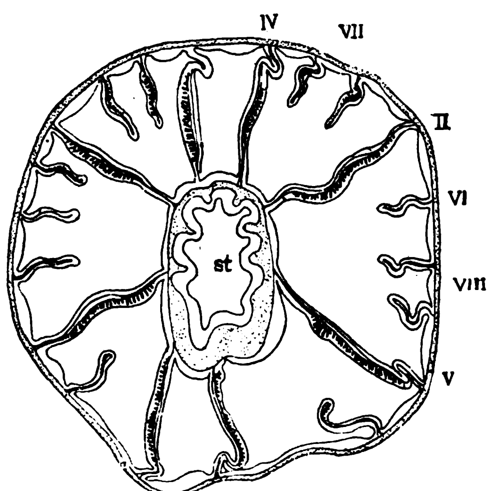

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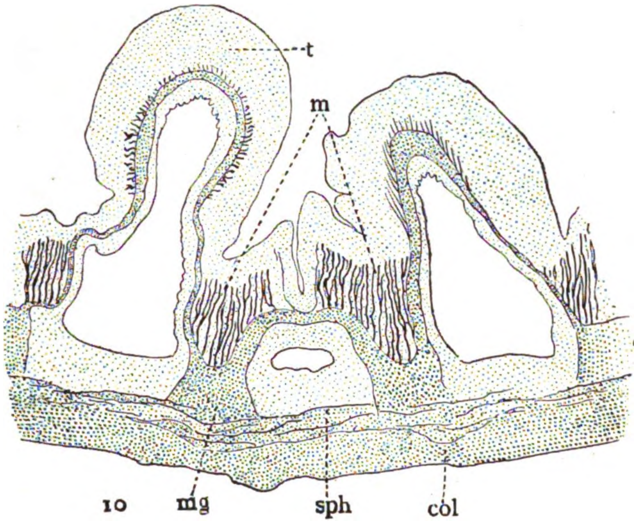
1-4. *Edwardsia intermedia.* 5-8. *Oractis Diomedeæ.*

9



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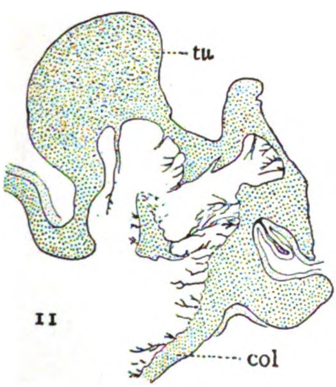

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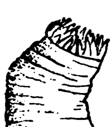

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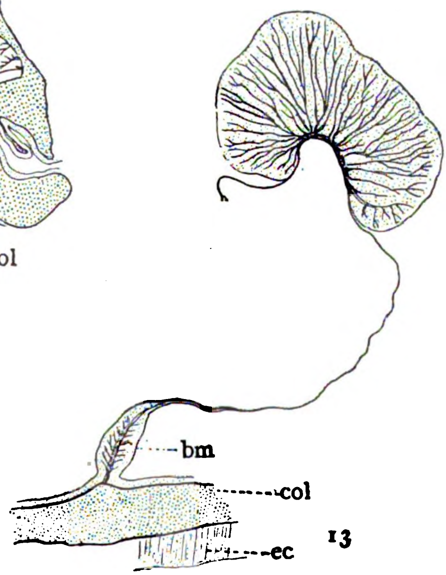

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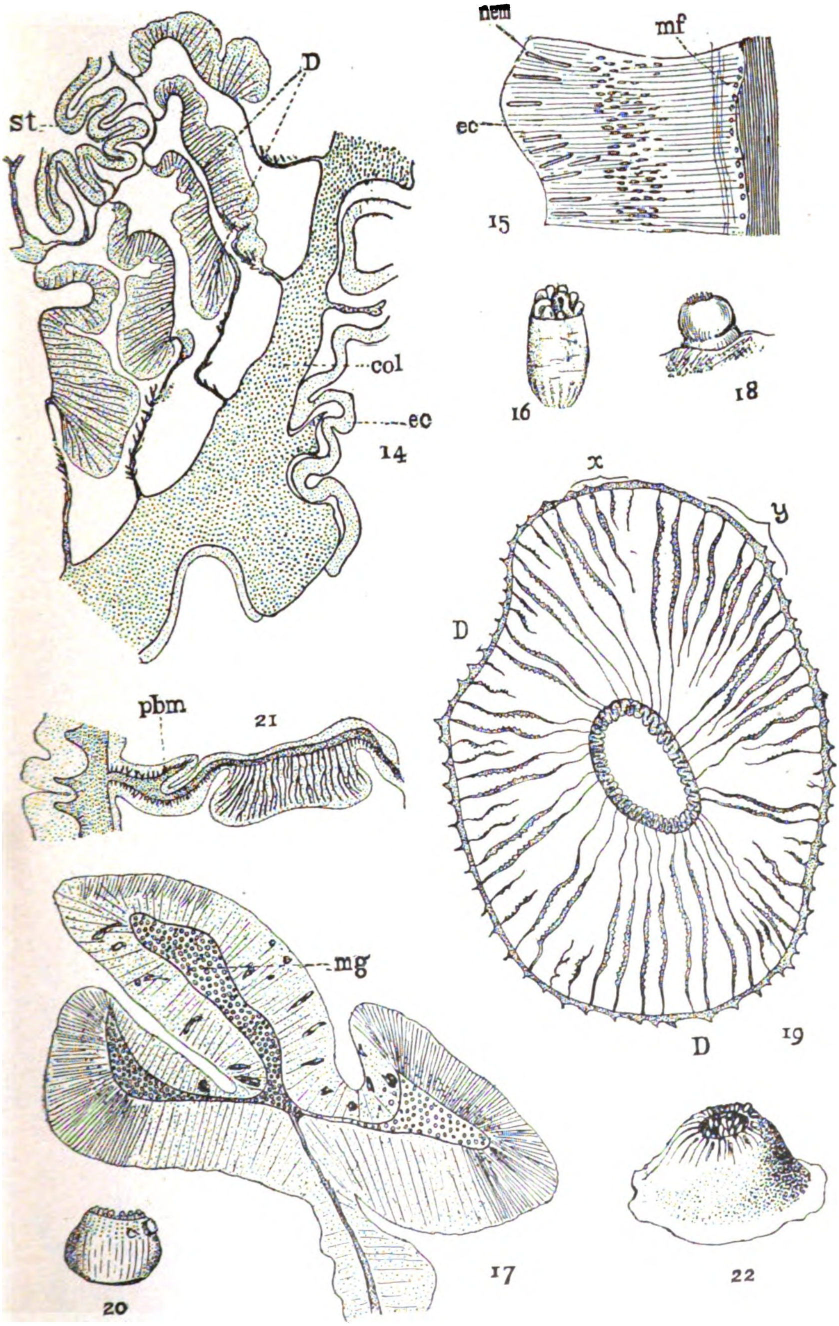
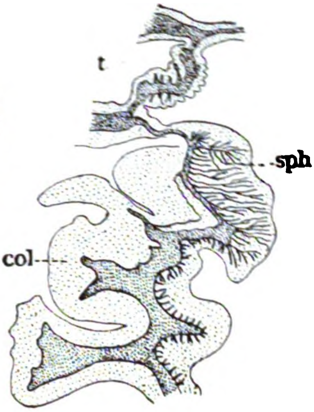
9–11. *Oractis Diomedeæ.* 12–13. *Halcurias pilatus.*



14-15. *Halcurias pilatus.*
18-19. *Anemonia variabilis.*
16. *Peachia Koreni.*
20-21. *Condylactis cruentata.*
17. *Actinia infecunda.*
22. *Myonanthus ambiguus.*

23



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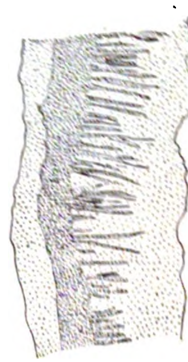

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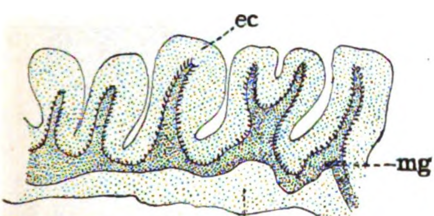

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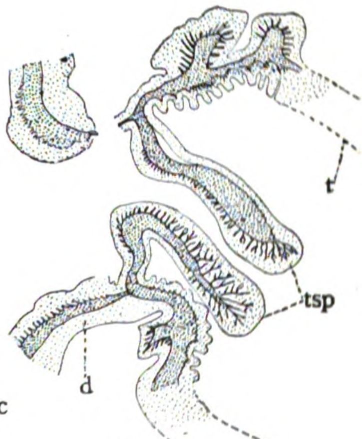

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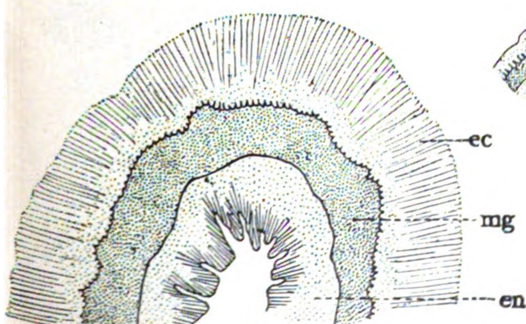

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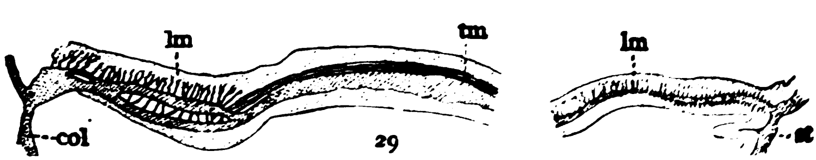

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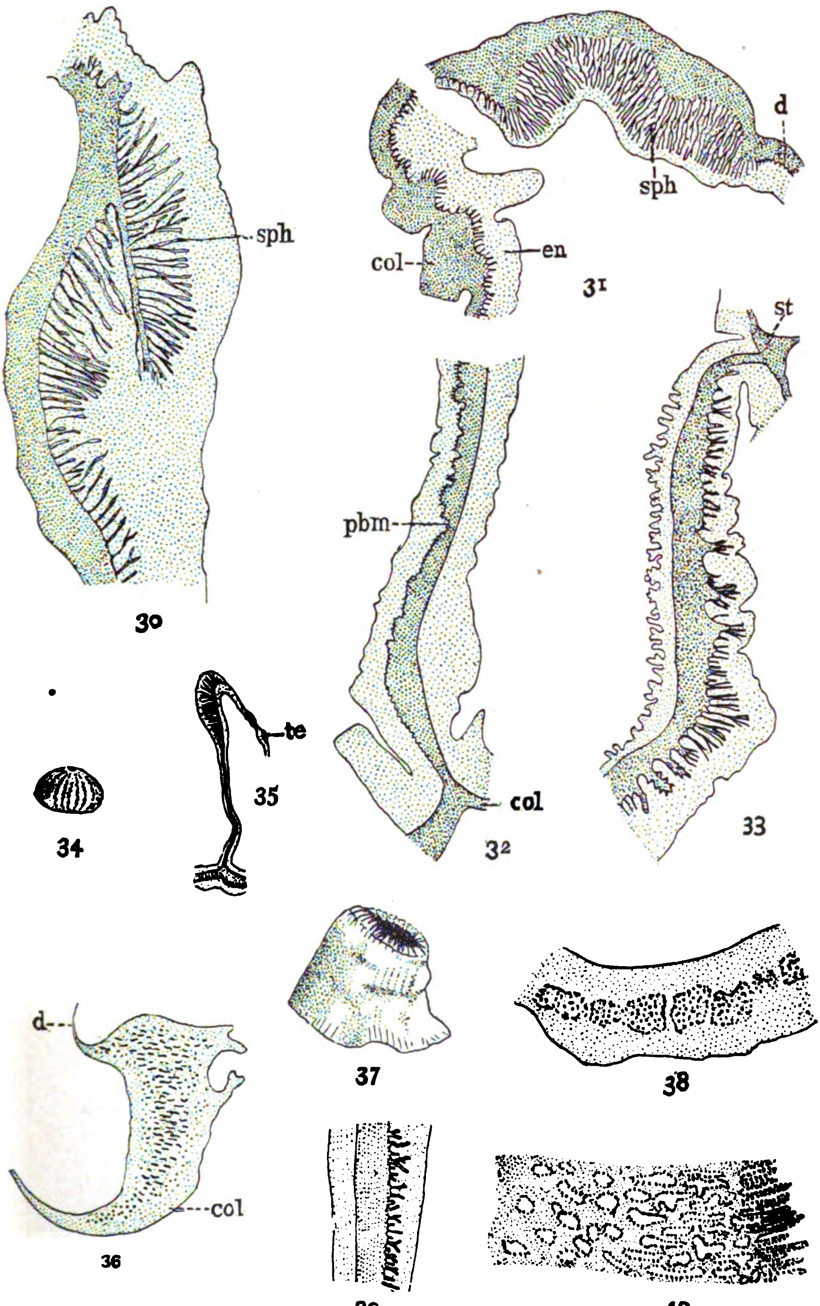
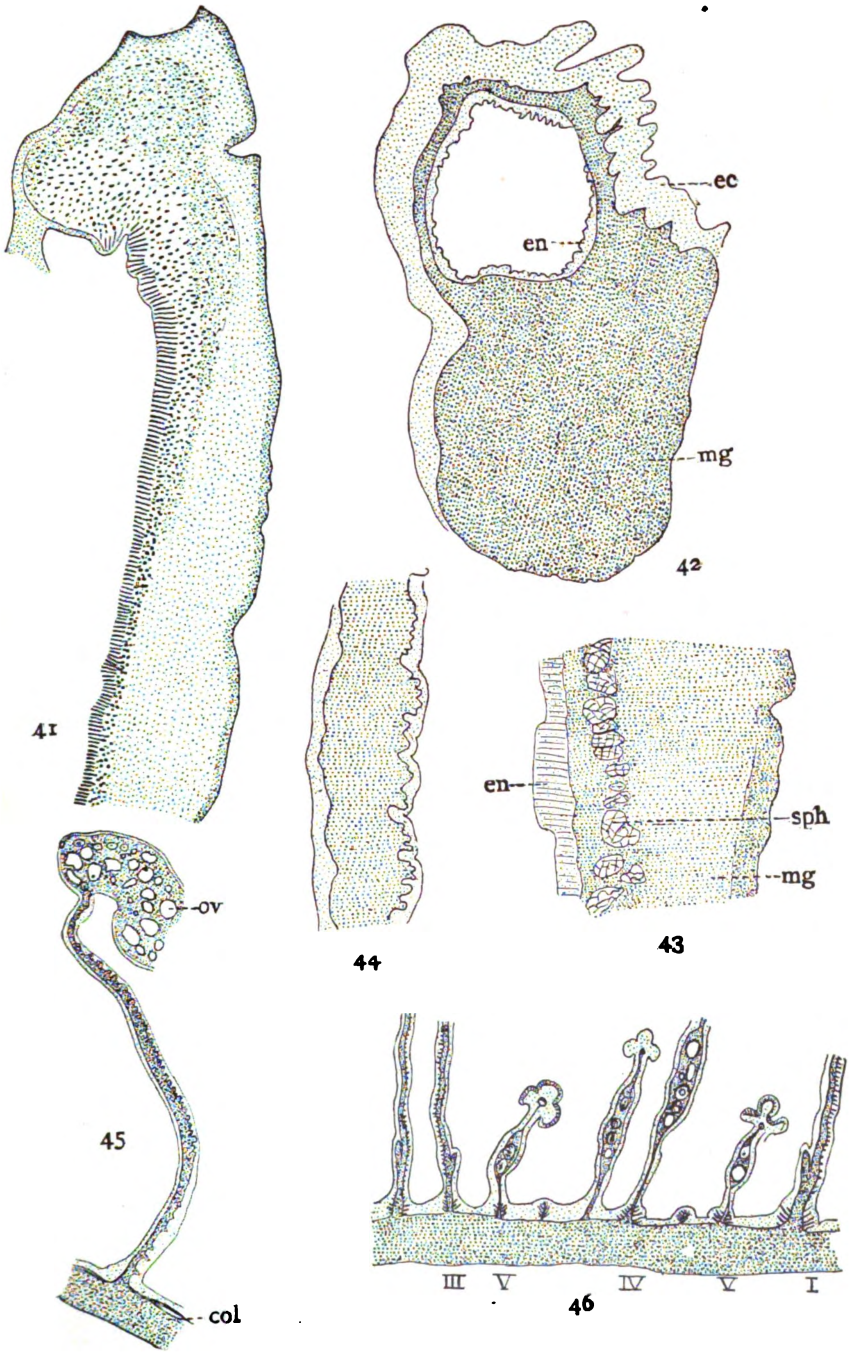
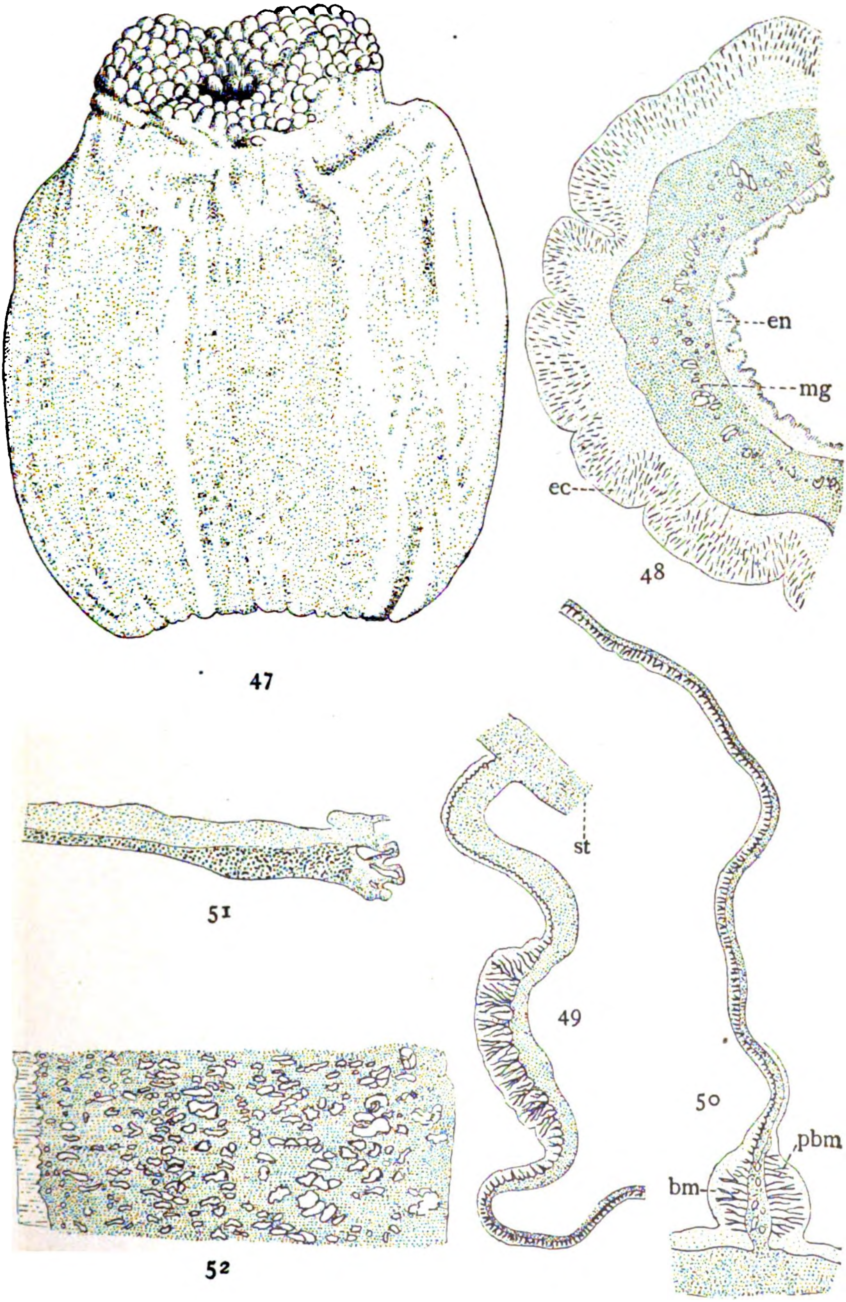
23. *Myonanthus ambiguus.* 24-27. *Bolocera occidua.* 28-29. *B. pannosa.*



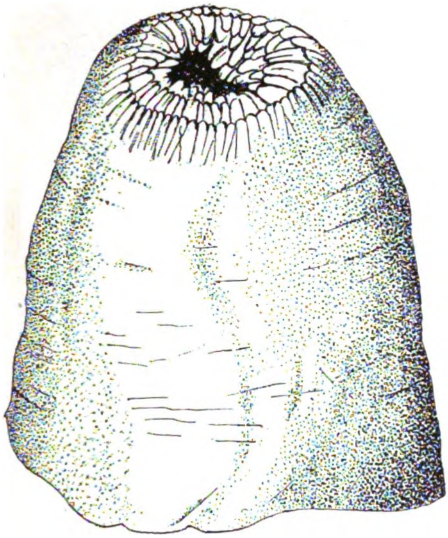
30. *Bolocera pannosa.* 31–33. *B. brevicornis.* 34–36. *Paractis lineolata.* 37–40. *P. vinosa.*



41. *Paractis vinosa*. 42-45. *Actinernus plebeius*. 46. *Actinostola callosa*.



47-52. *Actinostola callosa.*



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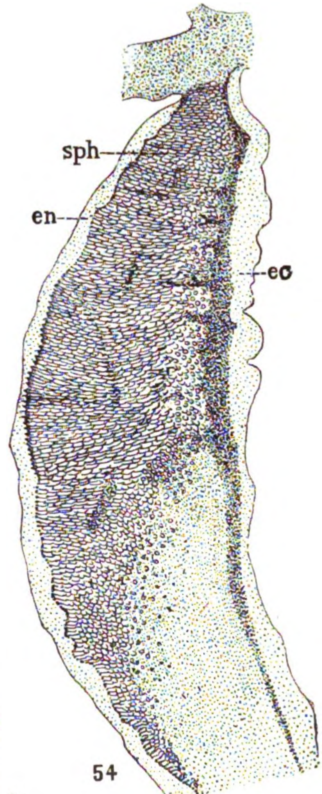

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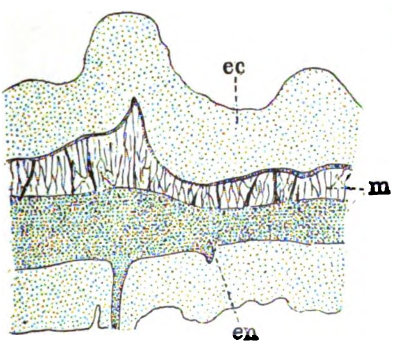

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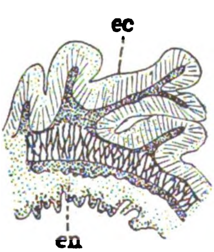

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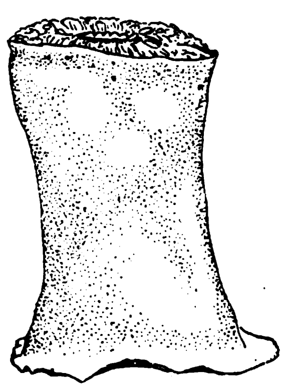

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53-56. *Actinostola excelsa.* 57-58. *A. pergamentacea.*

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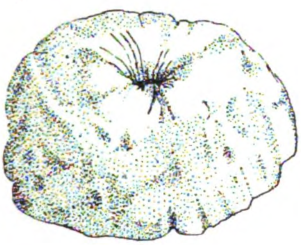
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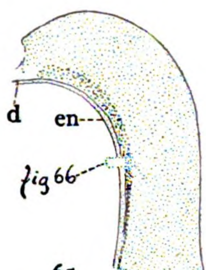

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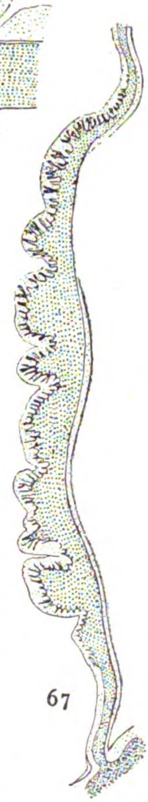
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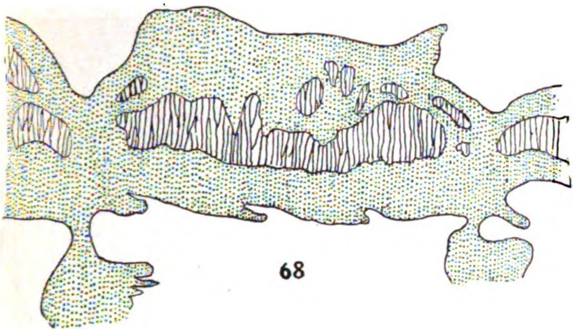
59–63. *Actinostola pergamentacea.* 64–67. *Pycnanthus maliformis.*



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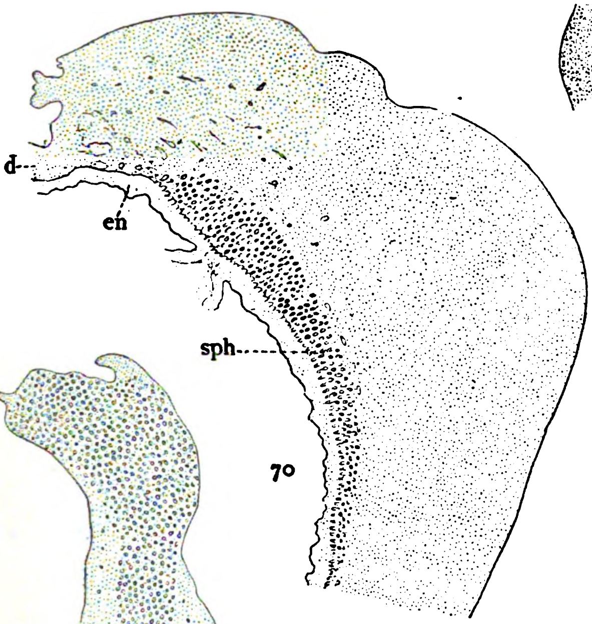

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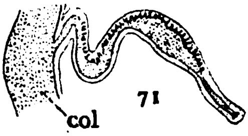

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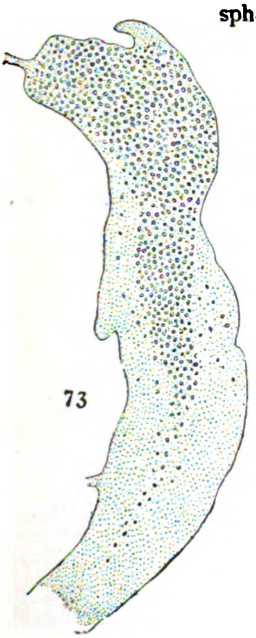

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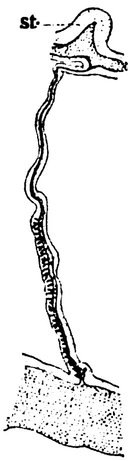

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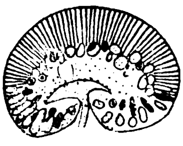

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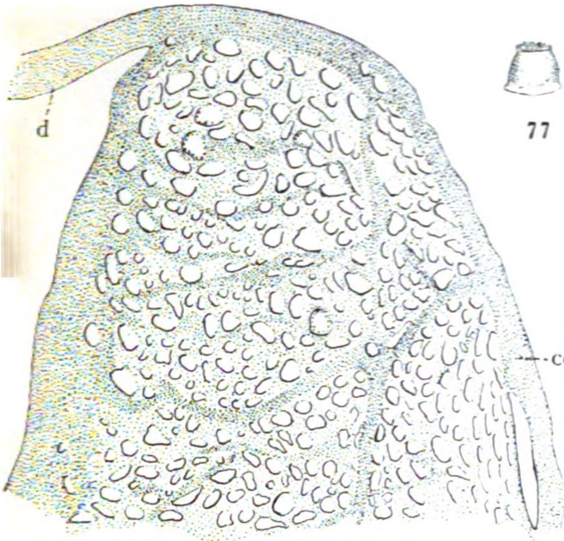
68. *Pycnanthus maliformis.* 69–71. *Cymbactis fæculenta.* 72–75. *Sagartia lactea.*



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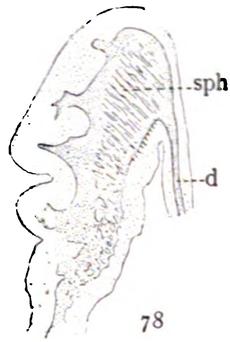

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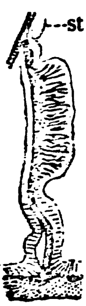

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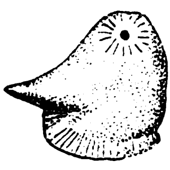

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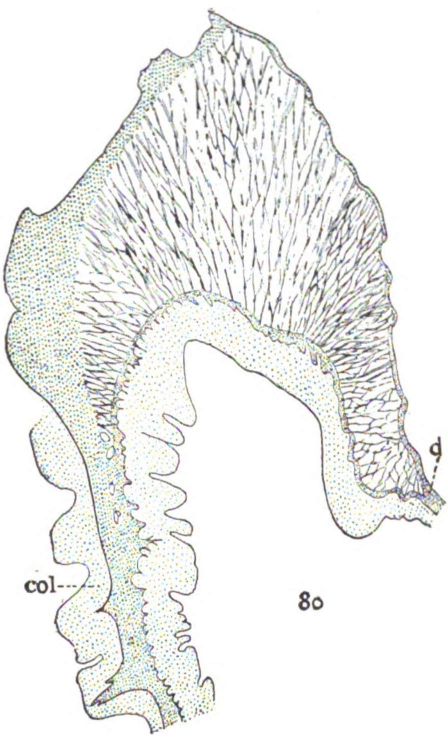

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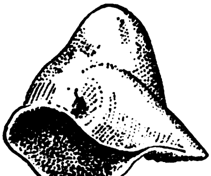

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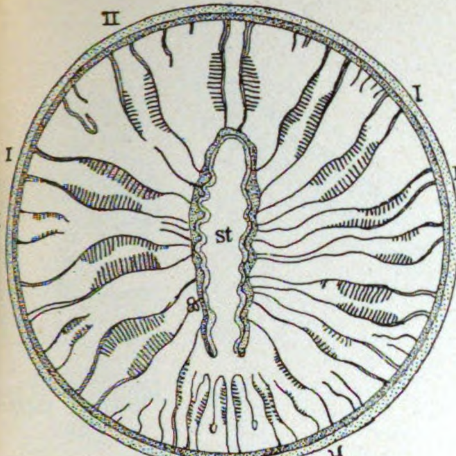
76. *Sagartia lactea.*
79-81. *S. paradoxa.*
77-78. *S. Sancti Mathæi.*
82-83. *Adamsia* (?) *involvens.*



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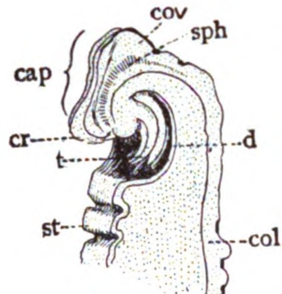

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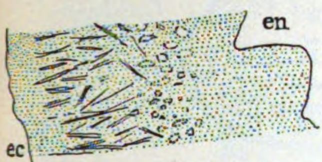

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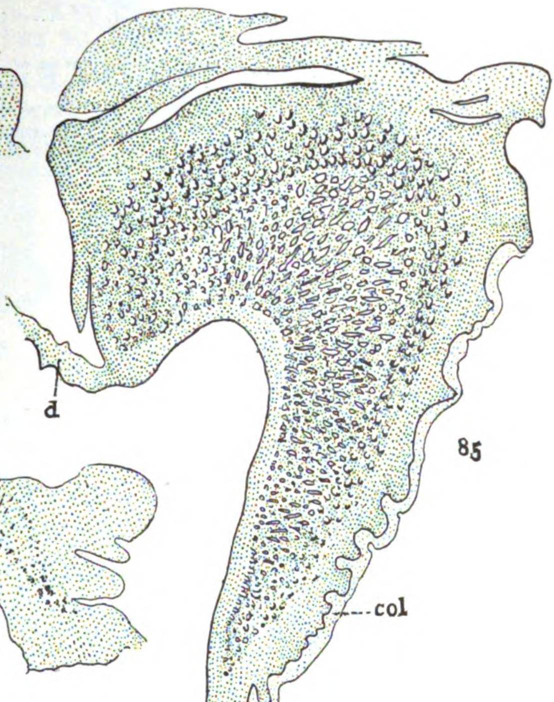

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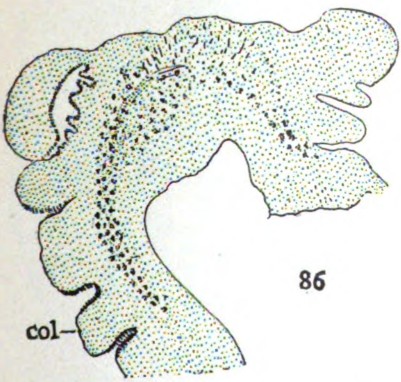

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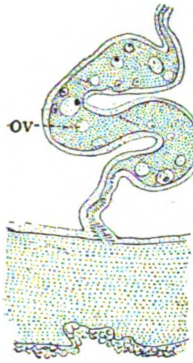
84. *Sagartia paradoxa.* 85. *Adamsia (?) involvens.* 86–89. *Actinauge Verrillii.*



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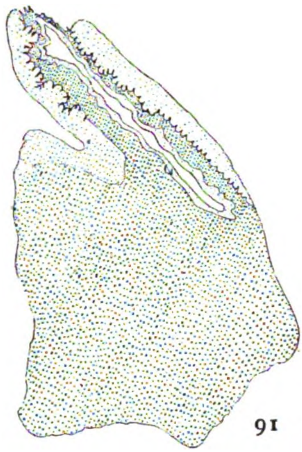

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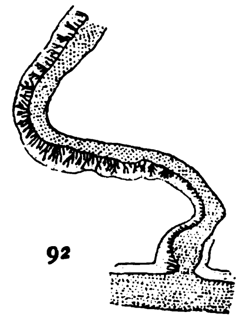

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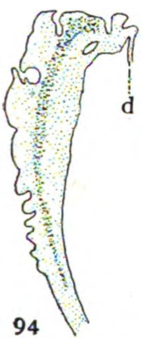

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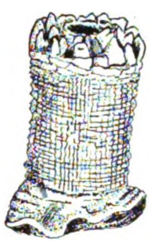

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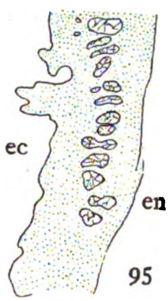

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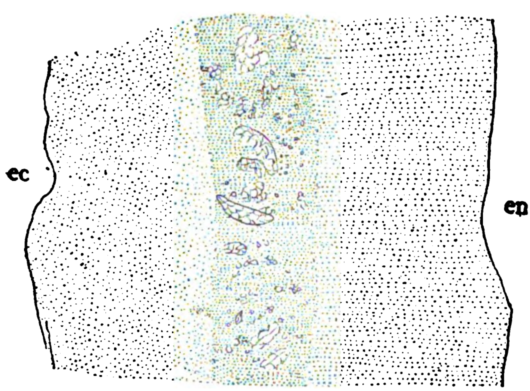

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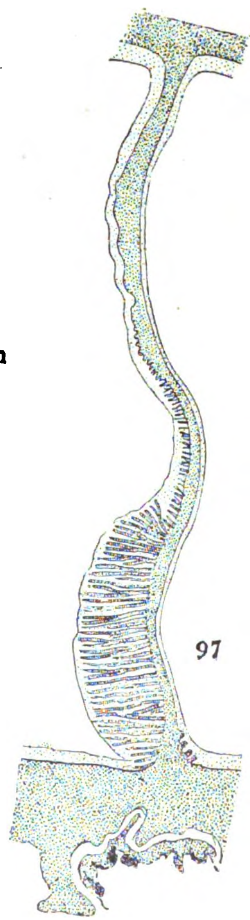

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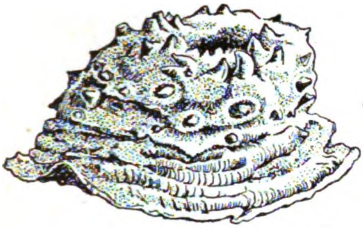
90–92. *Actinauge Verrillii.* 93–97. *A. fastigata.*



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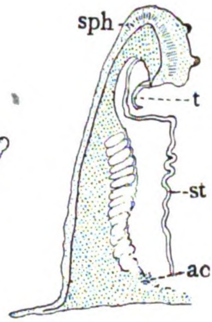

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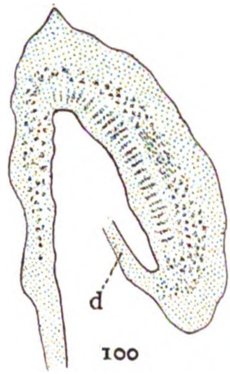

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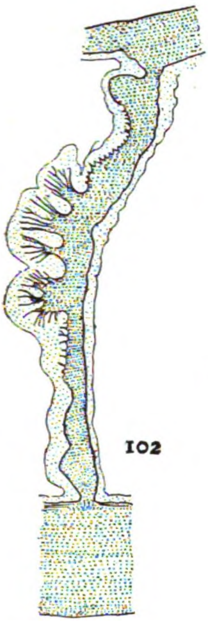

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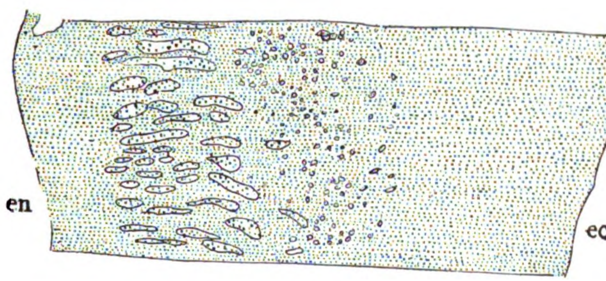

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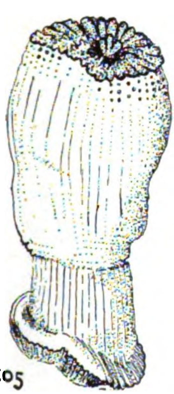

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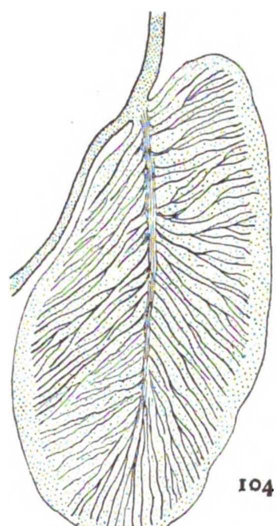

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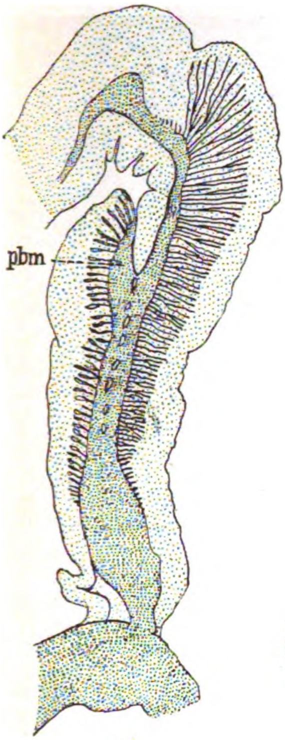
98-102. *Chitonanthus pectinatus.*
104. *Leiotealia badia.*
103. *Stephanactis hyalonematis.*
105. *Oulactis californica.*



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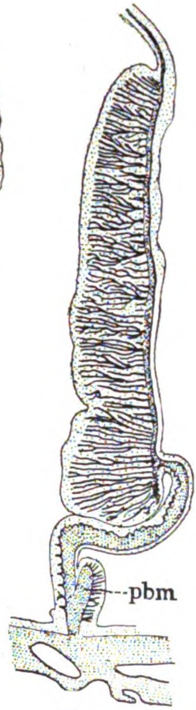

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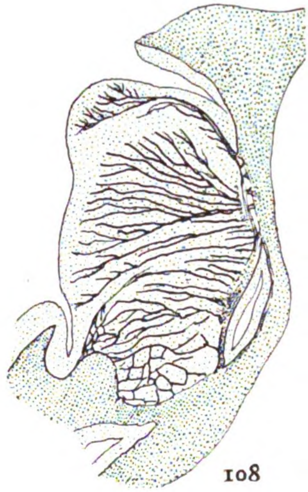

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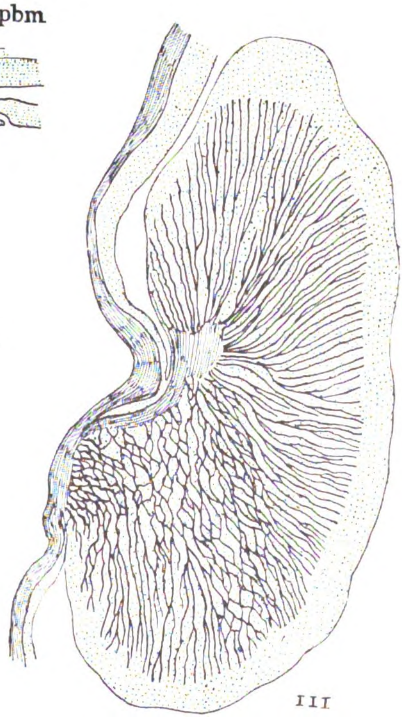

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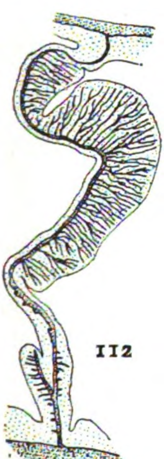

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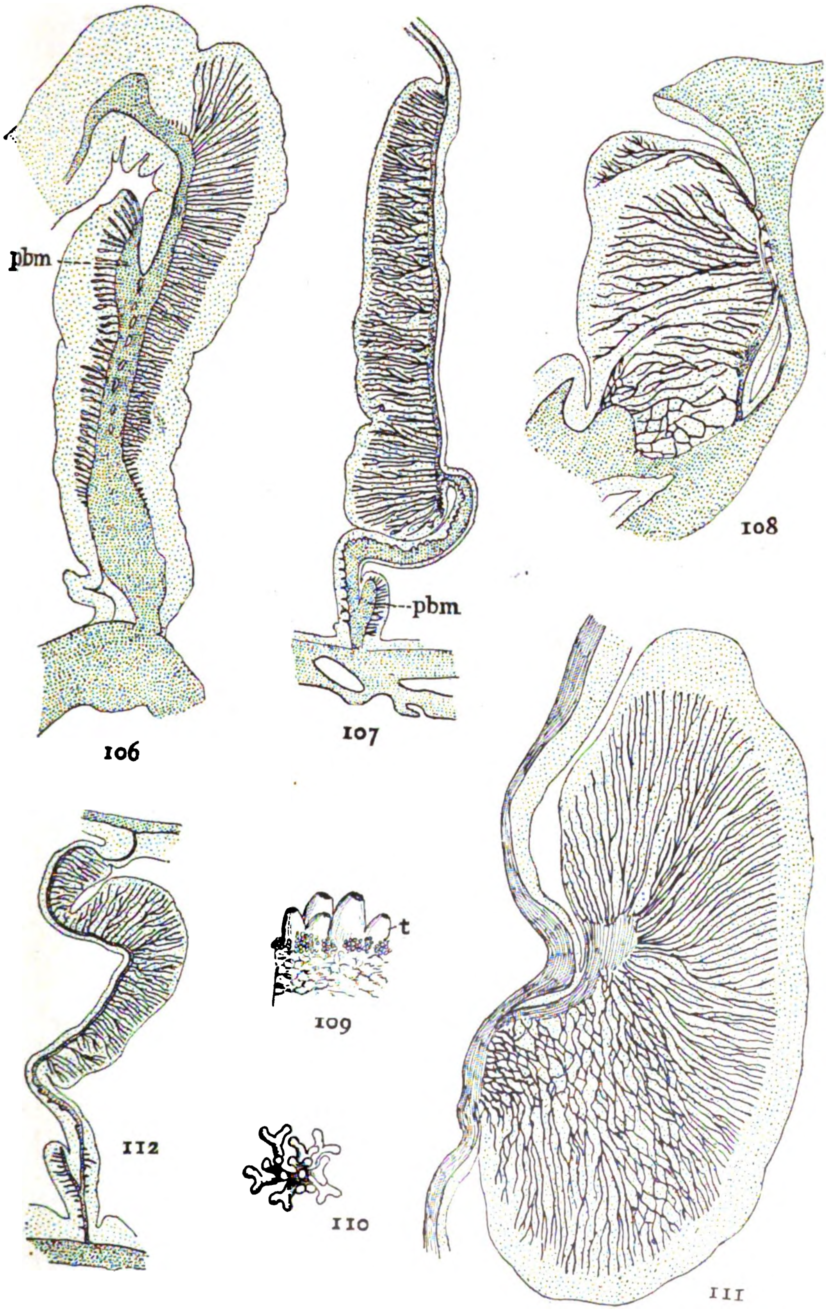
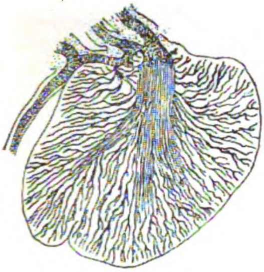
106. *Leiotealia badia.* 107–108. *Oulactis californica.* 109–112. *Cradactis digitata.*



106. *Leiotealia badia.* **107-108.** *Oulactis californica.* **109-112.** *Cradactis digitata.*



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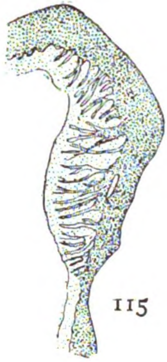

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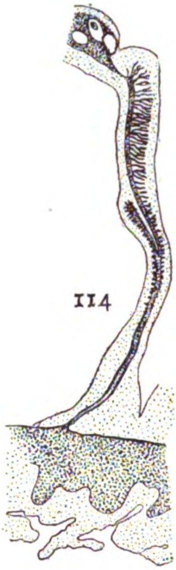

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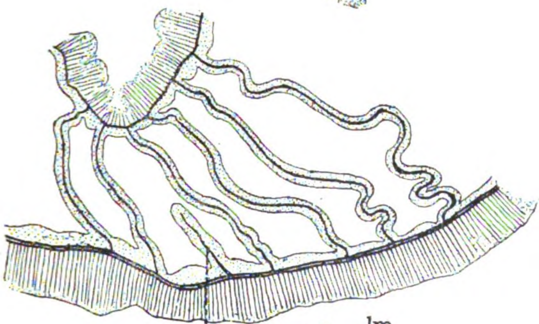

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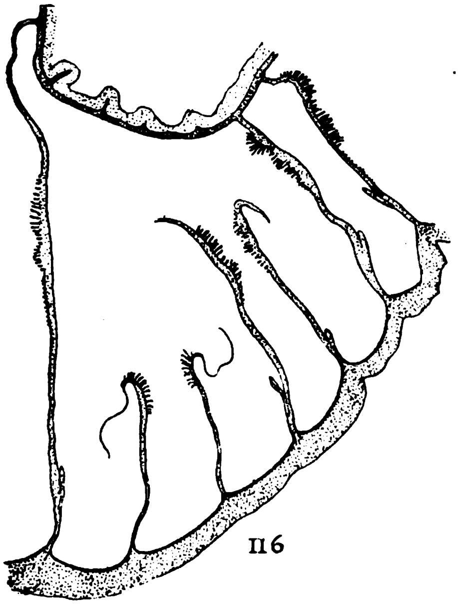

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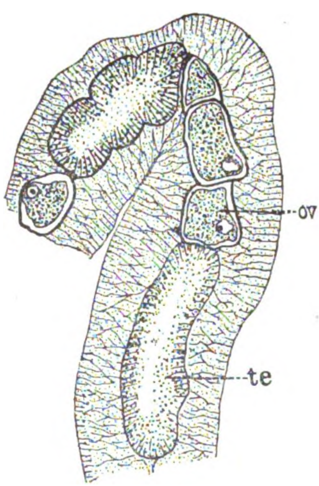

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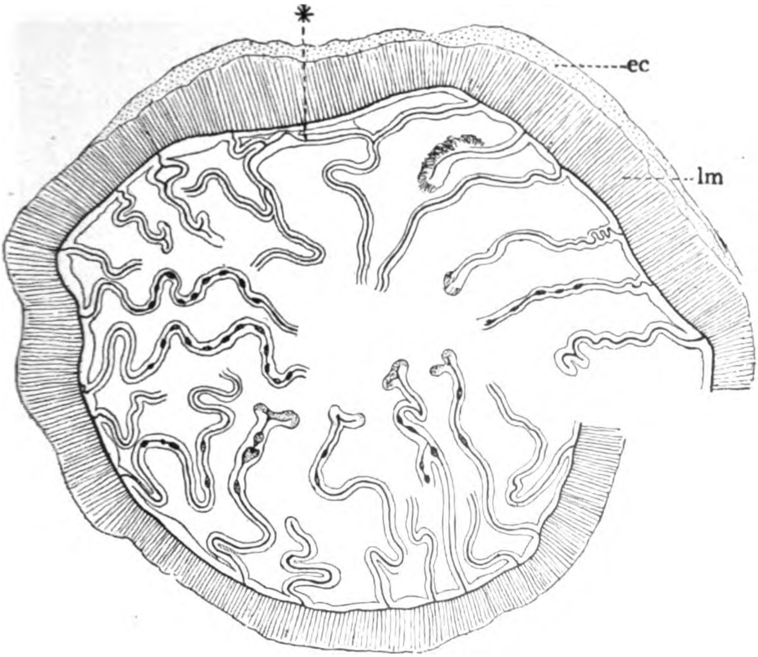
113–114. *Discosoma fuegiensis.* 115–116. *Anemonia (?) inequalis.* 117–119. *Cerianthus vas.*



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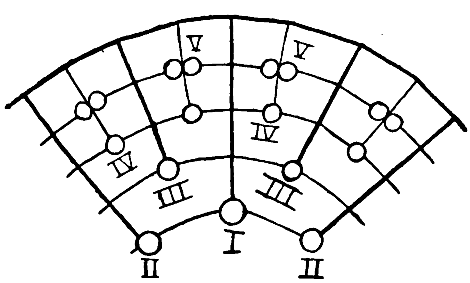

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120. *Cerianthus vas.* 121. *Actinauge Verrillii.*

ON THE STATUS OF THE GRAY SHRIKE, COLLECTED BY CAPT. BLAKISTON, IN YEZO, JAPAN.

BY

LEONHARD STEJNEGER.

A recent paper by Mr. H. E. Dresser (Remarks on *Lanius excubitor* and its Allies < Ibis, 1892, pp. 374–380), and especially his remarks on p. 378, on a certain specimen of gray shrike from the island of Askold, near Vladivostok, in Eastern Siberia, led me to reëxamine the only Japanese specimen ever taken, viz, U. S. National Museum, No. 96136, (Blakist., No. 1097, ♀; Mobitze, Yezo, March 9, 1873). The two localities are nearly under the same latitude (43° and 42° N.), and almost facing each other across the Japanese Sea.

Mr. Dresser describes the Askold specimen "as having no trace of vermiculations on the under parts, nor any trace of brown in the plumage, but it has a single alar bar, and has the rump and upper tail-coverts pure white," and he considers it "extremely puzzling," because, as he says, "in all the large series which I have examined this is the only specimen I have met with lacking the vermiculations on the underparts and all trace of the brown tinge in the plumage." However, it is plain from his subsequent argument and from the way he quotes Mr. Bogdanow in regard to the American *L. borealis*, that he believes the latter to be more or less brownish, even the fully adult. It is evident, then, that he is not acquainted with the adult *L. borealis*, which is quite as pure gray as *L. excubitor*, and if Mr. Dresser in all the large series he has examined has not seen an adult *L. borealis*, one might be tempted to believe that he has not met with the adult *L. major* (*Auctorum nec* WILKES), or *L. sibiricus*, as it is preferable to call it, except the Askold specimen.

The Japanese specimen above alluded to agrees in every particular with Dresser's description of the Askold bird. But, on the other hand, it also agrees most minutely (except outer tail-feather, which is whiter, a character of no value in these birds) with a specimen from Russia (U. S. Nat. Mus. No. 98550). Now, Dresser considers the European specimens unworthy of even subspecific rank (tom. cit., p. 375), but, if so, he ought to call the Askold and the Yezo birds *L. excubitor* pure and simple. I do not think he will do so; but then the Russian and the Askold-Yezo birds are most assuredly identical and indistinguish-

able, even by a splitter of so horrible a reputation as myself. What are we going to do in this dilemma?

Someone "anxious to lump" might take the horn of considering it now demonstrated that as (1) the European specimens with a single alar speculum have been "proven" to be nothing but *L. excubitor*, and (2) the eastern Asiatic birds are indistinguishable from these, the so-called *L. sibiricus* is also "proven" to be *L. excubitor* pure and simple; furthermore, as (3) it has also been "proven" that *L. borealis* is not even subspecifically distinct from *L. sibiricus* (Dresser, loc. cit., p. 379), it follows that even the North American bird must stand as *L. excubitor*. There seems to be some logic in this, yet I doubt if anyone will be bold enough to draw the consequences.

The other horn is this: The American adult bird (*L. borealis*), and I wish it understood that I speak of the adult birds alone, as I do not think it possible to separate all the young birds, is always* distinguished by having the under side cross vermiculated, and has always a single wing speculum; *L. sibiricus* also has a single wing speculum, but the fully adult bird is pure white underneath; *L. excubitor*, unmixed, has a double wing speculum. *L. borealis* is strictly confined to North America; *L. sibiricus* occurs from the Japanese Sea all through northern Siberia and northern Russia to Norwegian Finmark; *L. excubitor*, unmixed, is confined to central and southeastern Europe (broadly speaking). The boundaries of the two latter forms do now meet, or in certain places even overlap, interbreeding and consequent intermediate specimens being the result; but I have reason to believe that this meeting of the two species, in some places, at least, is of comparatively recent date.

The very great uniformity which *L. sibiricus* shows over such an enormous area, from the Pacific to the Atlantic oceans, as evidenced by the specimens referred to above, speaks in favor of its stability and its distinctness. And this point alone, if there were no others, is sufficient to induce me to select the latter horn of the dilemma. Whether this view of the case is the true one I think is beyond anybody's power to say for the present, for I do not believe that there is enough material in any one museum or city to decide, and I even doubt that all the specimens in St. Petersburg, London, and Washington to-day, if brought together, would settle the question beyond dispute.

In the mean time I think it perfectly safe to call the speci[illegible] from Askold and from Yezo *Lanius sibiricus* (Bogdanow).

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* "Always" in the sense which does not preclude possible exceptions due to *individual* variation.

THROWING-STICKS FROM MEXICO AND CALIFORNIA.

BY

OTIS T. MASON.

In the report of the National Museum for 1884 I published a short paper on the Eskimo "throwing-sticks" in the Department of Ethnology. The object of the article was to show how the methods and problems of natural history are applicable to the products and apparatus of human industry. Here we had a homogeneous people in blood and language, occupying a zoölogical area which we call hyperborean, and stretching out to cover Labrador, Greenland, all Arctic Canada, and the shores of Alaska, from the Mackenzie district all around to Mount St. Elias. It was with genuine pleasure that the author afterwards received from Dr. Seler, Mr. Murdoch, Dr. Stolpe, Dr. Uhle, Mr. Bahnson, Mrs. Nuttall, and Dr. Mortillet their own later contributions upon the same ingenious implement, with the acknowledgments that their publication was stimulated by the "Eskimo paper."*

In Science, for October 30, 1891, I gave a brief description, without figures, of an example secured for me on Lake Patzcuaro, Mexico, by Capt. John G. Bourke, U. S. Army. The apparatus was bought by this gentleman from a hunter, and may now be seen in the U. S. National

* Altmexikanische Wurfbretter, von Dr. Ed. Seler, Internationales Archiv für Ethnographie, Bd. III, 1890; The history of the throwing-stick, which drifted from Alaska to Greenland, by John Murdoch, Am. Anthropologist, July, 1890; Ueber altmexikanische und südamerikanische Wurfbretter, von Dr. Hjalmar Stolpe, in Stockholm, Internat. Archiv f. Ethnog., Bd. III, 1890; Ueber die Wurfhölzer der Indianer Amerikas, von Dr. Max Uhle, Mittheil. der Anthrop. Gesellsch. in Wien, Bd. XVII, n. F., VII, 1887; Ueber südamerikanische Wurfhölzer im Kopenhagener Museum, von Kristian Bahnson, Internat. Archiv f. Ethnog., II, 1889; Mrs. Zelia Nuttall, in a paper read before the Woman's Anthropological Society in Washington, entitled "The Atlatl or Spear-Thrower of the Ancient Mexicans, Arch. and Ethnol, Papers of the Peabody Museum, I, No. 3; Les propulseurs à crochet modernes et préhistoriques, par Adrien de Mortillet, Rev. Mensuelle de l'École d'Anthropologie de Paris, I, 15 août 1891.

Museum. The thrower is 2 feet 3 inches long, and has two finger-holes projecting, one from the right and one from the left side. In my paper on the Eskimo stick no case of two finger-holes occurs, and the only example in which a finger-hole projects from the side at all is from Point Barrow. Since the publication, however, another specimen comes from Cook Inlet. In Dr. Stolpe's paper is the exact counterpart of the Bourke specimen, only the latter has no ornament and is a practical every-day implement for killing ducks. The spear-shaft is 10 feet long, of slender cane, and has a hole at the after end for the hook of the throwing-stick. The gig consists of three iron barbs, for all the world like those on the Eskimo trident for water fowl.

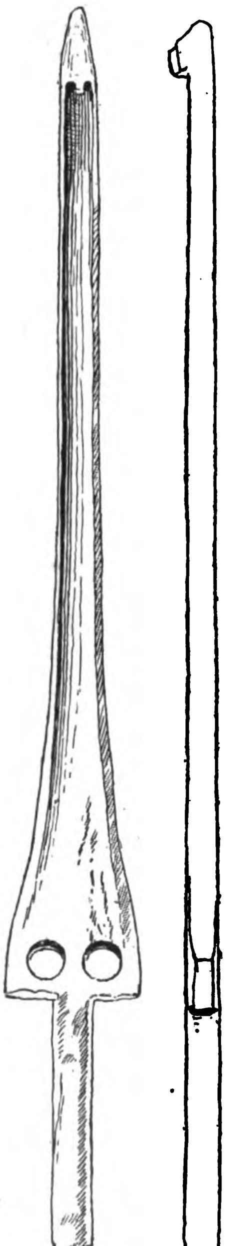

FIG. 1 *a*, *b*. Patzcuaro throwing-stick. U. S. Nat. Mus., Cat. No. 153020. (Capt. J. G. Bourke, U. S. A.)

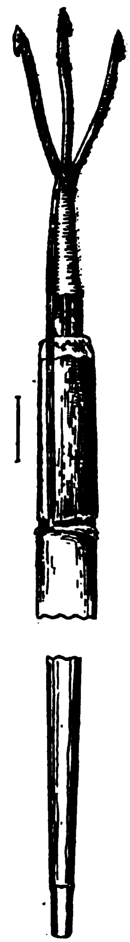

FIG. 2. Patzcuaro duck-spear. U. S. Nat. Mus., Cat. No. 153020. (Capt, J. G. Bourke, U. S. A.)

Mr. Charles H. Read read a paper on the 10th of March, 1891, before the Anthropological Institute, London, being an account of a collection of ethnological specimens found during Vancouver's voyage in the Pacific Ocean. Among the illustrations (J. Anthrop. Inst., Vol. XXI, Pl. XI, Figs. 1, 1*a*) occurs the picture of an *atlatl*, 5¼ inches in length, the shortest of which we have any record. The description given by Mr. Read is as follows:

"Spear-thrower of moderately hard, light-colored wood, pierced with two holes for the first two fingers. The hook is made of a piece of bone, rudely shaped. The whole seems to have been once covered with red color, now almost worn away. From the bone hook to the projection at the broad end of the implement is a shallow channel, as is usually found. This would seem to be the 'Santa Barbara throwing-stick' of the MS. catalogue, both from its similarity in work to the

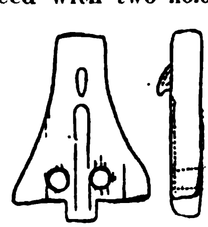

FIG. 3. Vancouver throwing-stick. British Museum. (C. H. Read.) J. Anthrop. Inst. Lond. 1891, pl. xi.

other Santa Barbara specimens, and from the fact that the other throwing-sticks in the collection correspond with their respective numbers in the catalogue."

Accompanying this specimen in the same plate is a harpoon bearing the following description (Fig. 2, Pl. XL): "Spear with loose head."

FIG. 4. Vancouver retrieving spear. British Museum. (C. H. Read.)

Now this Vancouver specimen is identical in every point with the one from Lake Patzcuaro excepting its length, and points at this moment to the most northern limit of the type, with finger holes on either side. Any-one familiar with the apparatus will see at once that it will fit either the right or the left hand, while the northern type will fit only one hand, usually the right.

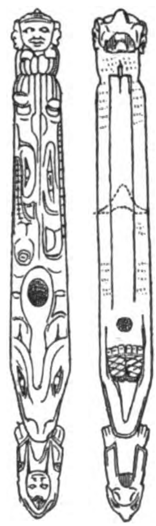

FIG. 5. T'lingit throwing-stick. British Museum. (C. H. Read).

In Pl. XVII of my former paper two very interesting old specimens are described from the Tlingit or Koloschan area about Sitka. One of these is figured in Ensign Niblack's monograph (Smithsonian Report, Part II, 1888, Pl. XXVII, Fig. 157). These specimens are very old, are covered with totemic devices, and represent a decayed art passed into its mythic stage. Similar apparatus is shown in Mr. Read's paper (Pl. XL, Figs. 3 *a*, *b*, *c*, *d*, *e*).

In this connection attention is drawn to a device for throwing a bird or fish spear found along the west coast of the United States, which slightly recalls Mr. Read's specimen. It consists of a flat piece of wood with notches for two fingers, and it is attached to the end of a long spear shaft. Historically this is not known to be either parent or descendant of the Vancouver example, but being found half way between Monterey Bay and the Tlingit area it raises one of those inquiries which stimulate further research.

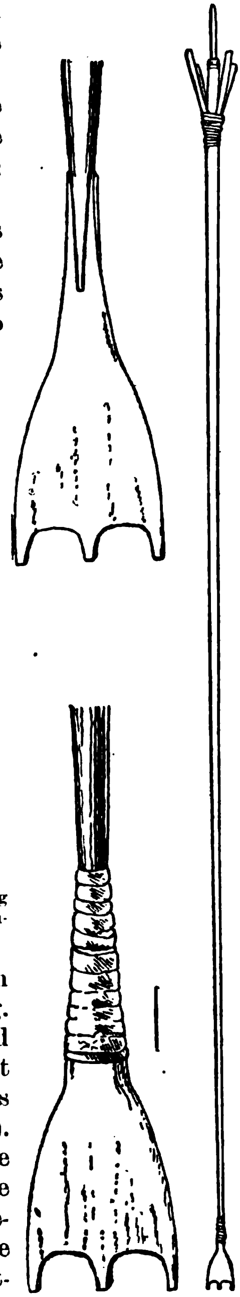

FIG. 6. Bird and fish harpoon staff, Makah Indians, Washington State. U. S. Nat. Mus., Cat. No. 72752. (J. S. Swan.)

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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No. XXIV.—DESCRIPTIONS OF NEW GENERA AND SPECIES OF CRABS FROM THE WEST COAST OF NORTH AMERICA AND THE SANDWICH ISLANDS.

BY

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Department of Marine Invertebrates.

Of the new forms described in the following pages, the Sandwich Island region is represented by seven species; of the west American forms all but two are found in southern California or Lower California, including the Gulf coast. In all six genera and forty-six species are described, of which four genera and forty species were collected by the U. S. Fish Commission steamer *Albatross*; of these forty species, seven had been previously collected by other parties, but had not been described. In the Proceedings of the Museum for 1891, 1892, and 1893 have been described seven new species of Panopeus, Periceridæ and Maiidæ from recent *Albatross* dredgings, making a total of forty-seven new species of brachyuran crustaceans collected by that vessel between July 1, 1888, and December 31, 1891. From this calculation are omitted the results of the cruise to the Galapagos Islands in the spring of 1891.

Family INACHIDÆ.

Subfamily LEPTOPODIINÆ.

Genus ERICERUS.

Carapace much elevated at the cardiac region. Rostrum long and simple. Postocular spine present. Abdomen of male six-segmented, the penultimate and terminal segments coalesced. On the sternum, in front of the abdomen, there are two spines pointing downward and forward, and situated on either side of the median line. The flagellum and a portion of the basal joint of the antenna are visible at the sides of the rostrum. Merus of the external maxillipeds with the inner

angle strongly produced, acute. Chelipeds much stouter than the ambulatory legs; merus trigonal, curved; hand broad and inflated; fingers no longer than the palm, arched. The ambulatory legs diminish rapidly in length from the first to the fourth; they are slender and subcylindrical; dactyli short and curved.

This genus is intermediate between *Metoporhaphis* and *Podochela;* it differs from the former in the relative length of the ambulatory legs and their dactyls, in the absence of the long spine from the meral joints, and in the broader hands and arched dactyls of the chelipeds; from the latter in the more elevated carapace and longer rostrum.

Ericerus latimanus.

Surface of carapace and legs pubescent. On the gastric region there are two small tubercles on the median line, the anterior the smaller; the cardiac region is armed with a prominent, blunt, well-rounded tubercle; there is a tubercle on the first abdominal segment; on the margin of the carapace there is a minute spine in front of the chelipeds, another on the hepatic region, behind which there is a third on the pterygostomian region. The rostrum is about as long as the postfrontal portion of the carapace; it is triangulate, acuminate, slightly curved upward, hollowed underneath for its proximal half, flattened above between the orbits. Orbital arch thickened. Basal antennal joint with a blunt tooth at the antero-external angle. Chelipeds spinulous on the inner margin, granulate beneath; merus with the outer margin irregularly tuberculate, and a spine on the upper surface at the distal end; carpus one-spined above; fingers dentate within, gaping except at the tips. Ambulatory legs hairy, especially on the penultimate joints; dactyls slightly curved, spinulous beneath.

Length of carapace, including rostrum 26, width 12 millimeters.

Collected by the U. S. Fish Commission steamer *Albatross* in the Gulf of California, at Concepcion Bay, Lower California, March 19, 1889 (17325); and off Adair Bay, Mexico, lat. 31° 21′ N., long. 113° 49′ W., 11 fathoms, sand, broken shells, gravel, temperature 67°, station 3024, 1889 (17324).

Podochela tenuipes.

Branchial regions flattened, hepatic moderately prominent, the gastric region rounded; cardiac prominence small, tuberculate. Rostrum thick, triangulate, acute. There is a small postocular spine or tubercle. The pterygostomian ridge is moderately developed. The abdomen of the male is composed of six segments, the last two normal segments coalesced; first two segments visible from above; first segment long; second very wide; from it the abdomen tapers rapidly to the last segment, which is long and rounded at the extremity. The abdomen of the female is pubescent, and fits over the thin erect laminiform expansion of the sternum. Basal antennal joint with a blunt longitudinal ridge on the posterior two-thirds of its length, which is a little nearer

the thin inner edge than the thickened outer margin and is divided from them by deep grooves. Merus joint of outer maxillipeds strongly produced on the inner side, deeply cut at the antero internal angle. In adult males the chelipeds are moderately robust, pubescent; merus trihedral, curved, outer margin spiny; the carpus has a superior, posterior spine; palm inflated, fingers shorter than the palm, gaping. In females and young the chelipeds are slender, the hands semicylindrical. Ambulatory legs long and slender, especially the first two pairs; with long hairs, those on the upper surface curled; dactyli falciform, toothed, in the first pair about one-third the length, in the remaining pairs about one-half the length, of the penultimate joints; these joints have no thumb processes, but in the last two pairs are slightly thickened in the distal half.

Length of male 14, width 9 millimeters. Length of female 14, width 10 millimeters.

Southern California; W. H. Dall (17505).

Lower California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
2999	24 54 30	110 39 00	39	crs. S.	63.6	17326
3001	24 55 15	110 39 00	33	fne. gy. S. brk. Sh.	64.5	17329
3039	24 27 00	111 59 00	47	fne. yl. S.	68.5	17327
3042	24 38 00	112 05 30	17	fne. gy. S.	65.0	17328

Podochela (Coryrhynchus) mexicana.

On the median line of the gastric region there are two tubercles, the posterior the longer. Cardiac and hepatic protuberances laminate, prominent. Rostrum hood-shaped, thin, ridged above, obtuse. Ridges of basal antennal joint thin, sinuous, subparallel, continued to the anterior extremity and expanded in a lobe near the posterior end. Pterygostomian ridge well developed. Chelipeds (of male) slender; palm little inflated; fingers meeting along inner edges. Ambulatory legs of moderate length; penult joints of last two pairs very slightly thickened toward the distal end; legs, except the dactyls, ornamented above with tufts of curled setæ; propodal joints with long straight hairs beneath; dactyls short, of last three pairs much curved and spinuliferous. Sternum and basal joints of legs vermiculated.

Length, 10; width, 8 millimeters; length of cheliped, about 12; of first ambulatory leg, about 27; of second ambulatory leg, about 21; of fourth ambulatory leg, about 11.

Off Adair Bay, Mexico, in the Gulf of California, lat. 31° 21′ N., long. 113° 49′ W., 11 fathoms, sand, broken shells, gravel, temperature 67°, station 3024, U. S. Fish Commission steamer *Albatross;* one male (17330).

This species much resembles *Podochela reisei* of the West Indies, but is at once distinguished by the shorter legs and the prominent margins of the basal antennal joint.

Podochela (Coryrhynchus) lobifrons.

Carapace pubescent. Cardiac protuberance prominent, surrounded by a deep sulcus; gastric region slightly swollen; hepatic prominence with a laminate, granulate projection. Postocular lobe large for the genus, thin and rounded. Pterygostomian ridge prominent, its lobe showing from above behind the hepatic lobe. Postocular, hepatic, and subhepatic lobes spinulous. Rostrum broad, thin, not produced beyond the antennular fossæ, slightly notched in the middle. The ocular peduncles have a spinule above, and traces of a spinule on the anterior and the posterior portions of the middle. Sternum deeply excavated in a transverse groove between the chelipeds, and in two rounded grooves in advance of the chelipeds. Male abdomen composed of six segments, the first of which is long and bituberculate on the median line. Basal antennal joint exceeding the rostrum, strongly angled, the anterior portion as deep as it is broad, the anterior surface deeply grooved for the insertion of the flagellum, which is half as long as the carapace. Merus joint of the external maxillipeds broad, truncate at the anterior edge, strongly notched at the antero internal angle, the inner margin prominent. Chelipeds stout, one-half again as long as the carapace, pubescent, spinulous; ischium and merus spinulous and spinous below and on the inner surface, the spines on the margins broad, flat, and ornamented with spinules; carpus strongly spinous above; manus broad and swollen, spinous on the margins, spines of the inner margin in groups; fingers widely gaping for one-half their length; a prominent tooth on the dactyl. Ambulatory legs very slender and pubescent, the first pair more than three times the length of the carapace; dactyls of first two pairs about one-third, of last two pairs about one-half the length of the penultimate joints; the dactyli of the last three pairs are falciform.

Length 20.5, width 18 millimeters.

A single male specimen was taken in the trawl by the *Albatross*, off Abreojos Point, Lower California, in lat. 26° 16′ 15″ N., long. 113° 42′ 15″ W., 58 fathoms, gray sand, broken shells, temperature 56°, station 3044, 1889 (17331).

Subfamily INACHINÆ.

Genus **ERILEPTUS**.

Carapace broadly triangular; regions well defined, convex. There is a postorbital and also a supraorbital spine. Rostrum slender and simple. Abdomen and sternum granulate; abdomen six-segmented. Basal antennal joint with a slender spine at the antero-external angle. Merus of external maxillipeds with a prominent obtuse lobe on the inner margin. Chelipeds very long, slender, subcylindrical; fingers short, arched. Ambulatory legs very slender, shorter than the chelipeds; dactyls almost straight.

Erileptus spinosus.

Carapace spinous; two spines on the median line, one on the posterior part of the gastric region, and the other on the cardiac region; there is one long spine on the branchial region, with a small one in front of it and two on the margin; a spine on the margin of the hepatic region, and two very small ones arranged transversely on the gastric region; there is a slender spine on the orbital arch. Rostrum slender, spinulous on the margins, about one-half the length of the post-frontal portion of the carapace. Postorbital spine small, at some distance behind the eye. The abdomen bears a spine on the first segment. Chelipeds nearly three times as long as the carapace, granulate; merus one-spined above at the anterior margin; hand slender, slightly flattened vertically, increasing in width toward the distal end; dactyl and pollex arched, gaping for one-half their length. Ambulatory legs decreasing regularly in length from the first to the fourth; fourth pair a little more than one-half the length of the first.

This species in the arrangement of its spines and in the rostrum resembles *Anasimus rostratus*, but the carapace is much broader posteriorly, the legs are different in character, and the postorbital spine is small and remote from the eye, while in *Anasimus* it is distinct and defines the orbit.

Length 10, width 6 millimeters; length of cheliped about 28.

Off San Diego, California, lat 32° 33′ 30″ N., long. 117° 16′ W., 36 fathoms, gray sand, temperature 58.2°, station 2934, U. S. Fish Commission steamer *Albatross*, 1889; two males (17341).

Anasimus rostratus.

Carapace with two median spines, one of which is on the posterior part of the gastric region and one on the cardiac region. There are two spines on each branchial region, and almost in line with these, one on each protogastric lobe. Lateral margins spinulous. Surface pubescent. Rostrum slender, spinulous on the margins, curving upwards for its distal half. There is a prominent supraorbital spine. The first article of the female abdomen carries a spine; the second article, one much smaller. Basal antennal joint very long and narrow, terminating in a spine, spinulous on the margins, without a prominent tubercle. Chelipeds very weak in the female; margins of merus spinulous; a slender spine above near the carpus; hand granulous; fingers nearly as long as palm, in contact. Ambulatory legs slender, much shorter than in *fugax*, pubescent, decreasing in length but little from the first to the fourth pair; dactyls spinulous below.

This species is distinguishable from *A. fugax*, A. Milne Edwards, of the Antilles, by the fewer spines on the carapace, by the more slender rostrum, and the shorter ambulatory legs.

Length, 7.5; width, 5 millimeters.

Northwest of Cerros Island, off Lower California, lat. 28° 58′ 30″ N., long. 118° 15′ 45″ W., 58 fathoms, gray sand, broken shells, temperature 55.8°, station 2983, U. S. Fish Commission steamer *Albatross*, 1889; two females, one of which is very small (17340).

Inachoides magdalenensis.

Carapace pyriform, regions distinct, with scattered tubercles and fine pubescence; gastric region with a transverse, arcuate row of tubercles across the middle, and a few tubercles on the posterior portion; cardiac region with a large elevated tubercle surrounded by smaller ones; branchial regions with many tubercles at the summit and a row near the margin; posterior margin with one tubercle; hepatic region with a spiny tubercle just below the margin. Rostrum of moderate length with anterior half slender. Postorbital spines distinct, acute. Sternum tuberculate and pubescent. Abdomen pubescent; in the male six-segmented, the sixth and seventh segments coalesced, and a spine on the first segment; abdomen of the female covered with large granules and longitudinally carinated. Spine at the outer extremity of the basal antennal joint short, acute. Merus of external maxillipeds strongly notched at the antero-internal angle. Chelipeds weak, stouter but much shorter than the ambulatory legs, pubescent; merus spinulous on lower outer margin; hand slightly inflated; fingers about as long as palm, gaping a little at the base in the male, not at all in the female. Ambulatory legs long and slender, regularly decreasing in length, pubescent; dactyls slightly curved.

This species can be distinguished from *I. microrhynchus* (Edwards and Lucas) by the weak chelipeds, from *lævis* Stimpson and *hemphillii* Lockington by the tuberculate carapace. In the description of *brevirostrum* by Lockington, no tubercles are mentioned, there is a small præorbital spine, and the ambulatory legs are evidently not all longer than the cheliped, as in the species here described.

Length of carapace in male 11, width 8 millimeters.

Lower California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3039	24 27 00	111 59 00	47	fne. yl. S	68.5	17337
3041	24 35 30	112 05 00	27	fne. gy. S	64.5	17338
3042	24 38 00	112 05 30	17	fne. gy. S	65.0	17339

Cyrtomaia smithi.

Description of an adult female: Carapace broader than long, granulous, finely pubescent on the anterior portion, very convex, broadly rounded at the branchial regions; cardiac and gastric regions elevated, the latter armed with three spines pointing obliquely forward, the posterior one on the median line and smaller than the other two. There is

a subrectangular space between these spines, which is flattened except for a low median ridge which becomes more prominent as it extends to the rostrum. Anterior portion of the carapace strongly deflexed. Cardiac region divided by a shallow longitudinal groove into two protuberances each terminated by a spine. There is a small spine on the anterior portion of each branchial region; a lateral submarginal row of small irregular spines is continued on the pterygostomian regions; a prominent triangular acute spine defines the outer angle of the orbit; there is another smaller flattened spine on the upper orbital border; and two spinules between, and in a line with, the supraorbital and the larger gastric spine; there is a small spine on the margin of the hepatic region. Rostral spines short, triangular, convex, horizontal, with a wide V-shaped interspace. Eyes large, stalks short, rather stout, with a spinule above at the distal extremity. Abdomen broadly oval with seven segments, granulate, carinate, carina spinuliferous. The sternum is armed with spines on its outer margins, and also around the margin of the abdomen, and on the median line in front of the abdomen. Antennæ with basal joint armed with three spines on the outer margin, and one on the anterior portion, the spines pointing downward; second and third joints flattened vertically, short, broad, spinuliferous on lower margins, the third joint reaching but little beyond the rostrum. Antennulæ lodged in cavities underneath the rostrum, the basal joint with its anterior margin thin and elevated. Exterior maxillipeds with ischium and merus spinous, merus with its antero-external angle produced into a flat, rounded projection, spinous on the margin.

Chelipeds about two and one-third times the length of the carapace, spinous; merus about as long as the propodus, more or less four-sided, the two rows of spines on the lower margins being the strongest; palm widening a little toward the fingers, with about six rows of spines; fingers each with a row of irregular teeth within, not fitting closely together. First ambulatory leg nearly twice as long as the cheliped, armed with slender spines, which are longer in the two rows beneath, and especially so in the last two joints, where the two rows are slightly curved toward each other, the spines directed toward the extremity of the dactyl. Second ambulatory leg two-thirds as long as the first, less heavily armed; dactyl unarmed. Last two pairs shorter, more slender, granulous, unarmed, except for a small spine at the distal extremity of the merus and a few spinules. Ambulatory legs slightly pubescent, except the dactyls, which are thickly hirsute above; dactyls slightly curved. Color of legs in alcohol pinkish, the long spines of a deeper shade.

Immature specimens differ from the above description in having the dorsal spines much longer and more slender, and additional spinules on the branchial region. The only male in the collection is about 12.5 millimeters long; the abdomen has seven segments, the carina is spin-

ous, and also the sternum; the chelipeds are similar in character to those of the females.

The largest specimen has a span of about one and a half feet.

	Millimeters
Length of carapace	49
Width of carapace	54
Length of cheliped about	112
Length of first ambulatory leg about	214
Length of second ambulatory leg about	152
Length of third ambulatory leg about	125
Length of fourth ambulatory leg about	120

With specimens from station 3474 there is an ambulatory leg of the first pair which is much larger than that of the largest specimen captured. The length of the last three joints is 153 millimeters, while in the specimen of which dimensions are given above the corresponding joints measure only 120 millimeters.

Off the Sandwich Islands, U. S. Fish Commission steamer *Albatross*, 1891:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3470	21 08 30	157 49 00	343	wh. S	43.3	17518
3473	21 15 00	157 30 00	313	fne. gy. S.	43.9	17519
3474	21 12 00	157 38 30	375	fne. wh. S.	....	17520
3475	21 08 00	157 43 00	351	fne. wh. S.	....	17521
3476	21 09 00	157 53 00	298	fne. wh. S.	....	17522

This species is quite distinct from the equatorial Pacific forms collected by the *Challenger*. *C. murrayi* has more spines on the carapace and a præorbital spine, while *C. suhmi* has longer gastric spines and no supraorbital spine.

Collodes tenuirostris.

Carapace slightly pubescent, conspicuouly granulate on the branchial regions, with a few granules on the gastric region and several on the intestinal region. There is a slender erect spine on the gastric region, one on the cardiac, and another pointing upward and backward on the first abdominal segment. These spines are slightly thickened at the summit. The posterior half of the rostrum has a rounded outline, the anterior half is a slender process in character like the dorsal spines, granulous toward the extremity. Supraorbital arch granulous, with a tubercle at the summit. In the male abdomen the fourth, fifth, and sixth segments have the lateral outlines separately concave; the sixth and seventh segments are anchylosed. Abdomen and sternum with scattered granules. Basal antennal joint with two small spines at the extremity, one below the other; outer margin spinulous; flagellum long. No interantennular spine. Chelipeds weak, much shorter than

the ambulatory legs, hirsute; the ambulatory legs more strongly so, the long hairs retaining large particles of mud.

Length of carapace, 11.5; width, 8 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3015	29 19 00	112 50 00	145	br. M	54.9	17332
3018	30 16 00	113 05 00	36	gy. S. brk. Sh	63.3	17333

Very much like *granosus* Stimpson, but at once distinguished by the rostral spine.

With the two males from station 3018, there is a small, immature female, in an imperfect state, which also belongs to the genus *Collodes;* the basal antennal joint is one-spined, and the dorsal surface is devoid of long spines; otherwise it resembles *tenuirostris*.

Euprognatha bifida.

Entire surface granulate. Carapace subtriangular, flattened behind, conspicuously granulate, regions well defined. There is a spine on the gastric, the cardiac, and each branchial region; a minute spine on the first abdominal segment, and two above the posterior margin; three tubercles in a transverse row on the anterior part of the gastric region. Lateral margins spinulous. Rostrum bifid, the interantennular spine being absent. Supraorbital and postorbital spines distinct. Spine of basal antennal joint thin and deep, advanced as far as the rostrum. Abdomen of male abruptly narrowed at about the middle; of female with a central carina and densely set with large, flattened granules. Chelipeds of male moderate, hand inflated, fingers gaping; of female very weak, hand slender, fingers longer than in male. Dactyli of ambulatory legs long, in first pair about half the length of the penult joints and about the same length as the antepenult.

Length, 9; width, 7 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
2998	24 51 00	110 39 00	40	S. brk. Sh	64.	17334
3001	24 55 15	110 39 00	33	fne.gy.S.brk.Sh.	64.5	17335
3014	28 28 00	112 04 30	29	gy. S.	62.9	17336

Subfamily ACANTHONYCHINÆ.

Sphenocarcinus agassizi.

Carapace tuberculate with an interrupted ridge along the median line; on the gastric region there are three flattened tubercles, the median one most prominent, in advance of the others and tipped ante-

riorly with a short spine; cardiac and branchial regions with irregular, lobate tubercles arranged transversely, the cardiac tubercles in advance of the branchial. Lateral margin, with three prominent, obtuse, flattened lobes, the first on the hepatic region; the first and second with their margins more or less right-angled; the third long and prominent. Rostrum entire for more than one-fourth its length; horns subcylindrical, contiguous to near their extremities. There is a small but distinct præorbital lobe. The merus of the cheliped has three small spines on the upper surface, one at the distal end, two near the proximal end; otherwise the legs are unarmed. The palm widens a little towards the fingers, which are gaping at base. Surface pubescent.

Length of carapace, including rostrum, 35 millimeters; width, 23 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Lon. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3011	28 07 00	111 39 45	71	fne. gy. S. brk. Sh.	57.9	17342
3019	30 28 00	113 06 30	14	bk. S. brk. Sh	66	17343

Pugettia dalli.

Adult males: Carapace subtriangular, with a tubercle on the intestinal region, one large on the cardiac region, and two arranged transversely on the gastric region; each of these tubercles is surmounted by a tuft of setæ. There are indications of two tubercles on the median line of the gastric region. Branchial regions without areolations. There is an upturned spine on the postero-lateral margin. On the hepatic region there is a slender transverse spine, curved slightly forward. The postocular tooth is thin, obtuse, its upper surface flattened in a smooth oval plate inclined downward from the horizontal at an angle of about 45 degrees. Rostral horns more slender than in *richii*, widely divergent. Præorbital spine acuminate. Rostrum and lateral margin of the branchial region hairy. Chelipeds strong; merus trihedral, with a prominent thin and irregular carina on the upper and inner margins; carpus strongly carinate above and on the inner margin, the outer and inner surface irregularly ridged; hand large, compressed, thin, especially toward the margins; palm nearly as broad as long; fingers gaping, a tooth near the base of the dactyl, and one on the pollex near the extremity of the gape. Ambulatory legs much more slender than in specimens of *richii* of equal size; first pair about as long as, or longer than, the chelipeds; three succeeding pairs short, decreasing regularly in length.

Females: These differ from the adult males not only in the broader and more rounded carapace, but in the areolations. There are three distinct areolations covering the branchial region; the gastric region

is much more swollen than in the male; the chelipeds are weaker, the hands narrow, the fingers in contact for nearly their whole length.

Young males: These resemble the females in the areolations of the branchial regions and in the chelipeds.

Dimensions of a male in millimeters: Entire length of carapace, 11; width, without spines, 6.5; length of cheliped, about 13; width of hand, 3.3.

RECORD OF SPECIMENS EXAMINED.

Southern California; W. H. Dall (17506).

San Diego; C. R. Orcutt (17371); 10 fathoms, H. Hemphill (4283).

Catalina Island, dredged January, 1863; J. G. Cooper (17372).

Lat. 34° N., long. 119° 29′ 30″ W., 30 fathoms, pebbles, station 2945, U. S. Fish Commission steamer *Albatross*, 1889 (17628).

This species is much smaller than *richii*, which is found in the same localities, and it is at once distinguished from the latter by the hepatic region; in *richii* it is dilated in two flattened horizontal spines, while in *dalli* it is furnished with one slender spine and a flattened obtuse oval tooth not horizontal.

Subfamily NEORHYNCHINÆ.

Neorhynchus mexicanus.

Carapace broadly triangular, convex; regions well marked; surface granulate and tuberculate, the tubercles becoming spinous on the lateral margins and on the summit of the branchial regions. On the median line there is a spiny tubercle on the posterior part of the gastric region, a stout spine on the cardiac and on the intestinal region. There is also a shorter spine on the first abdominal segment pointing upward and backward. Rostrum triangular, apex mucronate. Postorbital spines longer than the eyes, the tips pointing forward. Male abdomen with first segment long, one-spined; second, short; third, wide; next three segments gradually tapering; seventh, subtriangular, anchylosed with the sixth. Sternum conspicuously granulate, deeply grooved between the segments. Female abdomen with large flattened granules, five-segmented, the first segment with a spine; the second, third, and fourth, short; the fifth, suborbicular, convex. Basal antennal joint with its outer margin prolonged in a slender spine, slightly incurved, not quite so much advanced as the rostrum. Ischium of external maxillipeds, with the longitudinal groove deep; merus not so deeply cordate as in *depressus*. Chelipeds of male short, rather stout, granulate; merus spinulous on lower margins; hand broad, inflated, with a tubercle on the outer surface near the carpus; fingers nearly as long as the palm, gaping at the base. Chelipeds of female more slender than in the male, margins of hand parallel, fingers slightly gaping. Ambulatory legs long, slender, cylindrical, granulate under the lens, slightly pubescent, gradually diminishing in size from the first to the fourth; dactyls with acute horny tips.

The median spines present in adult males become tuberculate in females and smaller specimens, and the gastric tubercle is often absent.

Length of carapace 14½; width 12 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3013	28 23 45	111 58 00	14	gy. S. brk. Sh.	65	17345
3014	28 28 00	112 04 30	29	gy. S	62.9	17346
3020	30 37 30	113 07 00	7	gy. S. bk. Sp		17347
3022	30 58 30	113 17 15	11	gy. S. bk. Sp	66.1	17348
3029	31 33 00	114 20 30	10½	fne. gy. S. brk. Sh		17349
3030	31 07 00	114 29 00	20	M	64	17350
3031	31 06 45	114 28 15	33	bu. M	63.8	17351
3033	30 50 45	114 29 45	18	gy. M	63.5	17352
3037	27 45 00	110 45 00	20	gn. M	65.2	17353

Family PARTHENOPIDÆ.

Subfamily PARTHENOPINÆ.

Lambrus (Parthenolambrus) exilipes.

Carapace about one-third broader than long; narrow at the hepatic regions, spreading at the branchial regions; a cavity near the margin between the branchial and the small hepatic region; a large cavity between the branchial and the cardiac and gastric regions. Median tubercles four, one large on the posterior portion of the gastric region, one small on the genital, one large on the cardiac, and one small on the intestinal. There is a prominent tubercle at the summit of the branchial region, also a few low tubercles on the branchial region and on the gastric ridges leading to the rostrum. Antero-lateral margin convex, about eight-toothed; teeth denticulate, becoming smaller anteriorly, the row continued on the subhepatic region; tooth at the lateral angle the largest. Postero-lateral margin concave, arched upward, with five small teeth and a large upturned spine at the summit of the arch. Posterior margin slightly convex, tuberculate. The supraorbital arch bears a prominent tubercle. Rostrum channeled, subtriangulate, deflexed at an angle of about 45°. Male abdomen with seven segments. Sternum, abdomen, and merus of external maxillipeds tuberculate. Chelipeds long, irregularly dentate on the margins, teeth denticulate, a stout tooth on the lower side of the first joint; faces of merus with tubercles arranged more or less longitudinally; hand with a distinct ridge on the lower face, outer face somewhat tuberculous, inner face smooth; dactyl dentate on the outside near the base; both fingers dentate on prehensile edges, white at tips, in the right cheliped gaping at base, in the left in contact. Ambulatory legs very short, narrow, flattened; meral, carpal, and propodal joints with a denticulate crest above; meral joints with a narrow, longitudinal groove below, edges of groove denticulate; last two joints densely hairy underneath. Surface pubescent.

Length 10, width 13, length of cheliped about 25 millimeters.

Off San Domingo Point, Lower California, lat. 26° 07′ N., long. 113° 32′ W., 74 fathoms, fine, gray sand, temperature 55°, station 3043, U. S. Fish Commission steamer *Albatross*, 1889; one male (17365).

Mesorhoea gilli.

Carapace much broader than long. Surface minutely pubescent. Elevations of cardiac, gastric, and branchial regions angular, each prolonged in a three-sided spine, that on the branchial region situated on the postero-lateral margin. The angles or ridges are more or less crenulate or tuberculate. The two gastric ridges gradually diverge from the spine and are continued nearly to the front. The cardiac spine is longer than the others, compressed laterally so that its anterior face is narrower than its lateral faces. The branchial ridge is curved, subparallel to the antero-lateral margin and has a tubercle in the center larger than the others. In front of the branchial ridge are a few scattered tubercles; and there are one or two tubercles on the hepatic region. Behind the branchial ridge the surface is concave with the exception of the median spines. Rostrum very short, pubescent. Antero-lateral margin convex, distinctly crenulate; postero-lateral and posterior margins entire, thin, with faint impressed lines indicating the normal crenulation. Postero-lateral margin concave, about twice as long as the posterior margin, which is slightly convex in the middle, terminating in a triangular flattened spine at either angle. Ridge between the subhepatic and afferent channels minutely crenulate, pubescent, continued on the subbranchial region with several bead-like tubercles. Suborbital tooth strongly ridged. Male abdomen with first segment very short; second, widest with a transverse denticulate crest, having a larger denticle at the extremities and in the middle; third, fourth, and fifth segments anchylosed; sixth, wider than long; seventh, very short, triangular. Abdomen and sternum smooth. Female abdomen with seven segments; first segment in large specimen almost concealed under the carapace; second, with transverse denticulate crest; third, with a similar faint crest not continued to the margins. Basal antennal joint with a long trigonal spine below. Ischium of external maxillipeds punctate, outer margin pubescent, inner margin crenulate; merus with surface uneven, pubescent, anterior margin concave; a groove runs diagonally forward and outward across the surface; there are two tubercles on the outer side of this groove, one of which is at the antero-exterior angle; the inner angle is strongly produced and bears a granulate ridge. Chelipeds long and strong; merus trigonal, with margins irregularly dentate or crenulate; carpus more or less four-sided, margins finely denticulate or crenulate, a ridge running across the lower surface; hand long, trigonal, pubescent, upper surface slightly twisted, about ten teeth on the inner margin and thirteen smaller teeth on the outer margin, lower margin ten-toothed; dactyl at right angles to the upper sur-

face of the palm with a large, white, bead-like tubercle on the outside at the base. Ambulatory legs compressed; third, fourth, and fifth joints crested on the margins.

Dimensions of largest specimen, a female: Length, 15.5; width, 21; length of cheliped, about 33 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1888 and 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
2822	24 16 00	110 22 00	21	gy. S. brk. Sh	......	17367
3011	28 07 00	111 39 45	71	fne. gy. S. brk. Sh	57.9	17368
3014	28 28 00	112 04 30	29	gy. S	62.9	17369
3031	31 06 45	114 28 15	33	M	63.8	17370
3037	27 45 00	110 45 00	20	gn. M	65.2	17376

This species is apparently very much like *sexspinosa*, but differs from Stimpson's description in the larger cardiac spine, the curving branchial ridge, the distinct crenulation of the antero-lateral border, and in the long chelipeds.

Family CANCRIDÆ.

Lophozozymus (Lophoxanthus) frontalis.

Carapace with the regions well marked and crossed by faint granulated rugæ; somewhat hairy; slightly convex transversely, the lateral teeth somewhat upturned; more convex longitudinally. Frontal and antero-lateral margins granulate. Front more produced than in the other species of this genus, lobes sinuous, more advanced in the middle than at the obtuse outer angles; median notch deep, but closed. Upper orbital margin with two fissures, the intervening tooth more prominent than the adjacent inner portion of the orbit; external orbital angle a small tooth, widely separated from the antero-lateral teeth by a slightly sinuous margin. Antero-lateral teeth three, thick, triangular, acute. Inferior orbital border with a wide external fissure and two prominent teeth, the inner more slender and produced. Subhepatic and subbranchial regions granulate. Abdomen of male with second segment longer and narrower than the first, and narrower at its distal than at its proximal end, exposing a very small portion of the sternum; third segment touching the coxæ of the fifth pair of legs; penultimate broader than long; terminal segment rounded, almost semicircular. Chelipeds very stout; merus short, trigonous, with a row of bead-like tubercles on the upper margin; carpus large, rugose, a short, stout spine at the inner angle and a tubercle at the proximal end; hands with a broad, prominent lobe on the inner side of the proximal upper margin, the lobe turned inward; the pollex is curved downward, the dactyl arched; both are irregularly dentate within and gape somewhat

for their entire length, the tips hooked. The fingers are brown and mottled, the color extending far back on the palm, both inside and out. Ambulatory legs flattened, crested, hairy; propodal joints broad, about as long as the dactyls.

Small specimens have the carapace and upper portion of the hands rougher and the carpus very deeply eroded.

One specimen in the *Albatross* collection, without label, is associated with *Xanthodes taylori* and *Pachygrapsus crassipes*. A series of specimens loaned by the Peabody Museum of Yale University are from San Diego, California.

Cycloxanthus californiensis.

Carapace slightly convex, flattened behind, punctate and anteriorly rugose, wider than in *vittatus;* regions separated by shallow grooves and subdivided as in *vittatus*, but less distinctly. Antero-lateral teeth nine, besides the postorbital; the first depressed, lobate, the last two small, the last one being absent in small specimens; margin thick, teeth short, subacute. Front produced, more advanced in the middle than at the orbits, with a deep, closed median fissure; lobes each with a shallow sulcus, in some specimens almost straight. Abdomen broader than in *vittatus*, the second and penultimate joints noticeably shorter. Chelipeds with carpus and upper part of hand rugose; carpus with two blunt teeth at the inner angle; hands rather long, with upper and lower margins subparallel; fingers irregularly toothed, not gaping, grooved, light brown with white tips. Ambulatory legs hirsute on margins.

Length 24.5, width 37 millimeters.

RECORD OF SPECIMENS EXAMINED.

Catalina Harbor, California; beach (17509); 30 to 40 fathoms, sandy mud (17508); W. H. Dall.

San Diego, California; J. G. Cooper (17536); C. R. Orcutt (17499); H. Hemphill (17531).

Guadalupe Island, Lower California; U. S. Fish Commission steamer *Albatross*, 1889 (17395).

This species is much like *vittatus*, but differs from it in the shorter, blunter antero-lateral teeth, in the absence of hair on the margins, in the narrower hands, as well as in the characters mentioned above.

Lockington has described a species, *Xantho novem-dentatus*, from San Diego and Lower California (Proc. Cal. Acad. Sci., pp. 32 and 99, 1876), which he later (in annotations) decides to be identical with Stimpson's *vittatus*. Lockington says that the Lower California specimens are narrower than those from San Diego. He probably had two species, but there is nothing in his description to indicate that his type is identical with the species described above, excepting the broad carapace and the locality.

Xanthodes minutus.

Carapace transverse, convex anteriorly. Antero-lateral margin with three teeth, besides the orbital angle; posterior tooth minute. Carapace minutely granulate; regions well marked; the sinuses between the antero-lateral teeth are continued on the carapace; there is a tubercle near the first and the second tooth. Front very broad, deflexed; the two lobes convex, with very thin margins. The grooves leading backward from the median and lateral notches of the front are deep. Orbits with two closed fissures above. The basal antennal joint just reaches the front. Chelipeds almost equal, granulate; carpus with outer surface covered with about seven nodules, unequal in size and shape; hands with longitudinal grooves; fingers acute, dentate, brown, white at tips. Ambulatory legs punctate, striped with light color; dactyls light, hairy; remaining joints sparingly hirsute.

Length 3, width 4.2 millimeters.

Color in alcohol, dark purplish.

Off the Sandwich Islands, lat. 21° 14′ 51″ N., long. 157° 43′ 30″ W., 14 fathoms, sand, coral, station 3469, U. S. Fish Commission steamer *Albatross*, 1891; one male (17517).

The broad front and the nodulous carpi in connection with the relatively smooth carapace sufficiently distinguish this species.

Micropanope polita.

Carapace transverse, convex longitudinally, smooth and punctate posteriorly, rough-granulate anteriorly, the granules most prominent on the hepatic regions. Front broad, median notch narrow, lobes nearly straight, thin, denticulate. Areolations distinct. Antero-lateral teeth five (with the orbital angle); a concave sinus between the first and second; last tooth similar in character to the others, but smaller. Inferior regions of the carapace and surface of maxillipeds granulate. Sternum and abdomen smooth and punctate. Abdomen of male with five segments, the first and second broad, the second narrowest at its distal end. Basal antennal joint reaching the front. Anterior margin of merus of outer maxillipeds sinuous. Large cheliped, with merus finely granulate, dentate on the upper margin; carpus with spiny granules arranged in indistinct transverse ridges, an acute spine inside; hand granulate above and near the carpus, smooth and punctate elsewhere; palm broad, convex on lower margin; fingers brown, with lighter tips. The small cheliped differs in its much narrower, more granulate hand, with almost straight lower margin. Ambulatory legs slender, punctate, spinulous above, last three joints hairy.

Length of carapace 6.2, width 9.8 millimeters.

Off Magdalena Bay, Lower California, lat. 24° 58′ 15″ N., long 115° 53′ W., 36 fathoms, coralline, temperature 64.3, station 2989, U. S. Fish Commission steamer *Albatross*, 1889 (17397).

Menippe convexa.

Carapace more convex than in the American species of the genus; smooth to the eye, obscurely granulate under the lens; regions not defined, except the anterior portion of the mesogastric region and the epigastric lobes. Front with median lobes small, separated by a shallow sulcus, the margin sloping obliquely from each lobe to the inconspicuous lobe at the inner orbital angle. Antero-lateral margin marked with a sharp ridge. Postorbital angle not produced, separated by a shallow sulcus from the first tooth, which is the shortest; a slight emargination separates the first and second teeth; the third is most prominent; the fourth and last has a sharp ridge which extends back on the carapace. There are no tubercles on the inferior surface of the carapace. Chelipeds as in the genus; with depressed granules and punctures, most evident on the hands; hands not very deep, without striæ on the inner surface.

Length, 15.5; width, 21 millimeters.

Honolulu; one female (13908).

This species in its convexity approaches the East Indian *M. leguillouii* A. Milne Edwards, but differs in the character of the front and lateral margins.

Pilodius flavus.

Entire upper surface covered with long, soft, orange bristles. Carapace transversely oval; areolations distinct; five antero-lateral spines composed of single, sharp, distinct spines (the first two the smallest), with a few accessory spinules at their bases, the largest of which is behind the third spine. Carapace with spinules or granules near the antero-lateral margins, which are with difficulty distinguished under the covering of setæ. Front with a wide median emargination, separating broad arcuate lobes; lateral lobes small, less advanced; margin denticulate. Chelipeds spinous; merus with inner margin spinous, the spines longer near the carpus; carpus covered with spines, inner angle produced, two-spined; hand spinous on the outer and upper surface, the spines becoming tubercles toward the lower margin, almost naked within, smooth and shining; fingers meeting only at the tips, spoon-shaped, toothed on prehensile edges; dactyls spinulous above. Ambulatory legs spinulous above on third, fourth, and fifth joints; long-hairy.

Length, 6; width, 9 millimeters.

Color of carapace and chelipeds in alcohol, light yellow; ambulatory legs and bristles, orange; fingers, horn color, lighter toward tips.

Off the Sandwich islands, lat. 21° 14′ 51″ N., long. 157° 43′ 39″ W., 14 fathoms, sand, coral, station 3469, U. S. Fish Commission steamer *Albatross*, 1891; one immature female (17317).

Pilumnus gonzalensis.

Carapace much broader than long, strongly deflexed in front, flattened behind, covered with a short, dense, tough pubescence, each hair being regularly tapering, acuminate, not curved. When the hairs are removed the outlines of the mesogastric region are distinct; there are three or four spinules near the antero-lateral margin; otherwise the surface is smooth. Front spinulous and hairy on the margin, with a broad U-shaped sinus; the lateral lobes scarcely distinct from the median, but less advanced. Orbital margin armed with small spines. Antero-lateral margin evenly rounded, four-spined, the spine next the orbit being double, the two parts equally large; second spine also double, its anterior half the larger; all the antero-lateral spines have one or more accessory spinules. Subhepatic and subbranchial regions granulous. Ridge on the endostome distinct. Lower surface of the crab with a shorter pubescence than the upper. Chelipeds very unequal, outer surface pubescent and rough with short spines which are arranged in irregular lines on the hands. Toward the fingers and lower edge the large hand is naked, but punctate and finely granulous Fingers short, stout, and dentate on the prehensile edges; dactyls tuberculous above near the base. Ambulatory legs rather broad, hairy, the carpal joints longitudinally grooved on the outside.

Color in alcohol: The carapace when the hairs are removed is red, mottled with pale yellowish. The hairs are yellow; the spines and fingers are brown. In addition to the hairs the carapace and chelipeds of many specimens are covered with minute algæ.

Dimensions: Length 13, width 18 millimeters.

San Luis Gonzales Bay, March 27, 1889, U. S. Fish Commission steamer *Albatross;* eight males and thirteen females, four of which bear eggs (17415).

This species can be distinguished from the other described west American forms by the following characters: *P. depressus* Stimpson has the carapace flattened; *P. stimpsonii* Miers=*marginatus* Stimpson (name preoccupied by Stimpson himself for an Oriental species) has a tuberculate carapace, and a prominent antero-lateral margin; *P. xantusii* Stimpson is a narrow species; *P. spino-hirsutus* (Lockington) has the front long-spined; in *P. limosus* Smith the carapace is covered with tubercles.

Family PORTUNIDÆ.

Neptunus (Hellenus) iridescens.

This is the western representative of *spinicarpus* (Stimpson). It differs from that species in its more prominent ridges, in the obtuse frontal teeth, of which the median are narrower and more produced than the lateral; the eight small antero-lateral teeth are less sharp and their posterior margins more convex; the inner suborbital lobe is obtuse,

There are no adult specimens in the collection. The largest specimen is a female measuring 15 millimeters long, 35 wide including spines, and 22 wide between the bases of the spines. The long carpal spine reaches nearly to the base of the spine on the manus, and is no longer in the young males. The granulated ridge on the posterior portion of the gastric region is triangulate instead of ⊥-shaped, as in *spinicarpus*. There are four spines on the inner margin of the merus of the chelipeds. The postero-lateral angles are strongly upturned. The surface is iridescent.

Gulf of California and west coast of Lower California, U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3011	28 07 00	111 39 45	71	fne. gy. S. brk. Sh.	57.9	17444
3017	29 54 30	113 01 00	58	gn. M	61.8	17445
3033	30 50 45	114 29 45	18	gy. M	63.5	17446
3039	24 27 00	111 59 00	47	fne. yl. S	68.5	17447

Family OCYPODIDÆ.

Subfamily CARCINOPLACINÆ.

Genus ŒDIPLAX.*

Carapace very convex longitudinally, much resembling *Panopeus* in general appearance. Antero-lateral margin, with four teeth besides the postorbital. Eyestalks stout, orbits large, external hiatus broad. Antennæ and maxillipeds much as in *Panopeus*. Hands elongate; ambulatory legs flattened.

This genus belongs to that section of the Carcinoplacinæ in which the post-abdomen of the male does not cover the sternum between the fifth pair of legs. Although the classification in this subfamily is based largely on the arrangement of the segments of the abdomen in the male, it is true that there is a correspondence in the sexes in the width of the basal segments of the abdomen as compared with the width of the adjacent sternal segments. Therefore, although the species at hand is represented by females only, I feel justified in referring them to that group characterized by having only the anterior portion of the last segment of the sternum exposed. There are four described genera in this group: *Euryplax* Stimpson has the antennæ excluded from the orbit by the enlargement of the suborbital lobe; *Eucratopsis* Smith has very heavy chelipeds; in *Glyptoplax* Smith the merus joint of the exterior maxillipeds is triangulate, the hands are large and the front nearly horizontal. In *Panoplax* Stimpson there are but three distinct

* Οἰδέω, to become swollen; πλάξ, anything flat and broad; carapace. In analogy with Οἰδίπους (οἰδέω+πούς), the swollen-footed.

antero-lateral teeth, the carapace is depressed, and the orbits small, with a slight outer hiatus.

In *Œdiplax* the first segment of the abdomen is very wide and reaches the coxæ of the fifth pair of legs; the second segment is much narrower, exposing a large portion of the last sternal segment; the third abdominal segment is wider than the second, but not so wide as the first, nor does it reach the coxæ.

Œdiplax granulatus.

Carapace transverse, broadest at the last antero-lateral teeth; depressions between the regions shallow, excepting the hepatic and the branchio-gastric sutures; surface granulate; granules largest on the hepatic region, and almost entirely wanting near the posterior margin. Antero-lateral and postero-lateral borders about equal in length; antero-lateral teeth four, besides the postorbital, the third the largest; teeth granulate; sinus between the postorbital and the first tooth, and the space below the sinus denticulate. Front deflexed; median notch broad; lobes slightly sinuous. Orbit with two fissures above; inner tooth of inferior border prominent. Chelipeds not very unequal, roughened with spiny granules, arranged more or less in lines; merus short, trigonal, with a stout spine on its upper margin near the distal end; carpus rounded above with a large spine at its inner angle, and a smaller one at the base of the larger; dactyls granulate above for half their length; fingers toothed within, in the larger hand gaping, and with a large tooth at the base of the dactyl. Ambulatory legs hairy; merus joints spinulous on upper margin.

Length, 32.5; width, 46 millimeters.

Gulf of California, lat. 31° 06′ 45″ N., long. 114° 28′ 15″ W., 33 fathoms, brown mud, temperature 63.8°, station 3031, U. S. Fish Commission steamer *Albatross*, 1889; two females, one immature (17465).

Speocarcinus granulimanus.

Carapace very convex longitudinally, almost straight transversely, deeply and irregularly punctate, obscurely granulate near the margins. The mesogastric region is distinctly outlined; a deep sulcus separates the hepatic and branchial regions from the gastric and cardiac regions; between the hepatic and branchial regions there is a deep, smooth pit. Front two-lobed, with a narrow median groove from which a sulcus extends backward to the mesogastric region; lobes with almost straight margins, sloping forward and outward from the middle. Frontal, orbital and antero-lateral margins granulate. Orbit with two fissures above, the outermost broad and open. Antero-lateral margin arcuate; teeth four, not prominent, separated by very narrow sinuses; outer margins of the first three teeth rounded, the first (the orbital tooth) the longest, the others decreasing successively in length; last tooth small, acute, directed outward. Postero-lateral margins nearly straight

and parallel. Suborbital border with an outer hiatus and a broad, rounded inner lobe. First segment of the male abdomen very short and wide; second, longer and much narrower; third, as wide as the first at its proximal end; from this point to the distal end of the penultimate segment the margin of the abdomen is markedly concave; the three divisions of the coalesced segment faintly indicated; terminal segment rounded, about as long as broad; abdominal appendages long, slender, and curved. Merus of external maxillipeds produced at the antero-lateral angle in an acute angle. Chelipeds slightly unequal; merus obscurely granulate, margins tuberculate, a small spine near the distal end of the upper margin; carpus granulate with a spiniform tooth at the inner angle; hand granulate, with longitudinal rows of tubercles on the palm and on the margins; fingers broad, not gaping, deflexed, coarsely toothed within. Ambulatory legs smooth, shining, sparingly punctate; dactyls margined with hair; remaining joints sparsely hairy. The margins of the carapace and the upper margin of the hand are sparsely hairy, while the inferior portions of the carapace, the upper margin of the merus, the inner margin of the carpus, and the abdomen of the female, are thickly fringed with hair.

Length, 17; width, 21 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3031	31 06 45	114 28 15	33	bn. M...	63.8	17460
3035	30 21 00	114 25 15	30	gy. M...	62	17461

This species can at once be distinguished from *carolinensis* by the less prominent antero-lateral teeth, by the shape of the front, and by the granules of the hand.

Carcinoplax dentatus.

Carapace broader than long, very convex longitudinally, less so transversely, regions slightly marked; surface microscopically granulate and pubescent. An indistinct arcuate ridge extends transversely across the gastric region and joins two others running longitudinally across the branchial regions; from these ridges the carapace slopes downward to the frontal and lateral margins. Front about one-third the width of the carapace, nearly straight, thick, two-edged, and deeply grooved, with a faint median notch. Supra-orbital border denticulate, with two fissures, the outer one broad. Antero-lateral teeth three, broad, separated by wide sinuses, margins denticulate; first tooth at the orbital angle, with nearly straight sides; second with outer margin convex, inner concave; third tooth similar to the second, but narrower. Postero-lateral margins nearly straight. Male abdomen with seven segments, not entirely covering the sternum at its base; first joint no wider than the second, neither reaching the coxæ; third joint very wide, touch-

ing the coxæ of the fifth pair of legs; from the third segment to the extremity the abdomen is almost triangular, the sides very little concave; terminal segment longer than broad, obtuse; appendages widely separated at base, terminating in long slender filaments crossing each other near the tips. Maxillipeds widely gaping; meral joint with anterior margin concave, inner margin convex, palpus articulating at the antero-interior angle. Chelipeds equal, granulate; merus with a tooth above, one-third the distance from the distal end, and one near the distal extremity of the lower outer margin. Carpus short and broad, a sharp curved spine on the inner side near the proximal end; outer surface of carpus and manus covered with long hair; hands compressed, spinulous on the lower margin, smooth inside, except for a line of spinules running from the lower margin near the pollex diagonally backward; upper margin with a small spine at the anterior extremity; fingers bent downward, irregularly toothed within, not gaping, curving toward each other at the tips. Ambulatory legs long and slender, clothed with downy hairs, which are longest on the last three joints; third pair longest.

Length, 14; width, exclusive of teeth, 16.3 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3016	29 40 00	112 57 00	76	gn. M	59.0	17462
3017	29 54 30	113 01 00	58	gn. M	61.8	17463
3035	30 21 00	114 25 15	30	gy. M	62.0	17464

The chelipeds of this species in shape and hairiness are very like those of *C. vestitus* (de Haan), but that species is broader and has much smaller antero-lateral teeth, as well as other striking differences.

Subfamily OCYPODINÆ.

Gelasimus gracilis.

This species is the west coast representative of *pugnax* Smith, but is distinguished by the more convex carapace, much wider posteriorly, the more transverse anterior margin, making the carapace more rectangular. The front is narrower and consequently the supraorbital border is longer than in *pugnax*. The male abdomen is much narrower than in *pugnax*, and the second segment much shorter. The ischium of the outer maxillipeds is very broad and convex. The large cheliped of the male has the joints relatively longer and more slender than in *pugnax*; the merus is crossed by transverse tuberculate rugæ, and the inner margin is tuberculate or denticulate; the carpus also has the inner margin tuberculate, the outer surface roughened with flattened tubercles arranged more or less in striæ, and the inner surface crossed diagonally by tubercles; the palm is narrow near its articulation with the carpus and is very finely tuberculate or granulate, the granules be-

coming so small on the lower half as to be scarcely perceptible to the naked eye; on the inner surface of the palm an oblique tuberculate ridge extends from the lower margin to the depression into which the carpus fits, and joins another tuberculate ridge running to the upper margin; the space between this ridge and the dactyl is not tuberculate as in *pugnax*, but smooth and shining, except for the two lines of tubercles near the base of the dactyl; the fingers are longer and more slender than in *pugnax*, the pollex with a large tubercle near its middle and the dactyl irregularly tuberculate with a large tubercle not far from the base. The meral joints of the ambulatory legs are longer and more slender than in *pugnax*.

Length, 10; width, 15 millimeters.

RECORD OF SPECIMENS EXAMINED.

San Diego, California; H. Hemphill, 1872 (17504).

Todos Santos Bay, Lower California; H. Hemphill (17576).

La Paz, Lower California; L. Belding (4622).

San Luis Gonzales Bay, Lower California; U. S. Fish Commission steamer *Albatross*, March 27, 1889 (17458).

This species might perhaps be referred to Lockington's *crenulatus*, except that he describes the outer surface of carpus and manus as smooth.

Gelasimus latimanus.

This species is represented by a single male specimen, found among a large lot of *Gelasimus gracilis* from La Paz, Lower California, L. Belding (17500). It differs from all described species except *gibbosus*, in having the abdomen five-segmented; and from *gibbosus* in the entirely different character of the hand and fingers which are short and broad. The carapace in general appearance resembles that of *gracilis* except that it is broader and much more convex; it is smooth to the eye; front and orbits similar to those of *gracilis*; eyes shorter and stouter. First segment of abdomen very short; second equaling the first in length; fourth, fifth, and sixth anchylosed. Maxillipeds very convex. Larger cheliped short; merus and carpus with outer surface rugose, and inner margin denticulate; propodus shorter than the width of the carapace; palm broad, outer surface closely set with distinct granules, which become tuberculate near the upper margin; inner surface with the lower proximal portion granulate, the distal portion smooth, the two parts not separated by a sharp ridge; parallel to the base of the dactyl there are two lines of tubercles, the posterior line continuous with the granules on the edge of the pollex. Fingers granulate, much shorter than the palm, broad, little gaping; the pollex rounding upward, the dactyl slightly arched and overreaching the pollex but little. Smaller cheliped with palm broad and fingers widely gaping, but not so much so as in *gibbosus*. Ambulatory legs with a few long hairs, especially on the last three joints.

Length, 6.3; width, 10; length of cheliped about 18 millimeters.

This may be identical with a short-fingered specimen from the west coast of Lower California, which Lockington doubtfully refers to *stenodactylus*.

Gelasimus coloradensis.

Carapace very convex, regions protuberant, smooth; there is a longitudinal groove crossing the branchial region, and this groove opposite the posterior margin of the gastric region widens into a deep pit from which fine irregular grooves radiate; cervical suture deep, with a pit near the frontal margin. Front broad. Posterior or upper edge of the superior orbital border curving forward and outward, with smooth margin; anterior or lower edge denticulate, curving rapidly downward near the base of the ocular peduncle, then gradually rounding upward to join the posterior margin at a little distance from the antero-lateral angle of the carapace, which is acute and points forward. The lateral border is marked by a sharply upturned and finely denticulate margin which slopes inward anteriorly, so that the carapace is much narrower at the antero-lateral angles than posterior to them; and the posterior portion of the lateral margin is strongly incurved and terminates opposite the cardiac region. The inferior orbital border is marked by about twenty-four distinct tubercles. The eyestalks are slender and do not nearly fill the orbit. The jugal region is covered with depressed tubercles. Male abdomen broad, second segment much shorter than the first, sixth segment wider than the fifth; appendages slender. Ischium of outer maxillipeds wide and smooth; merus short. The left cheliped (the larger in the one specimen at hand) is very long; merus as long as the carapace, rugose, inner margin finely tuberculate; carpus also rugose, inner margin tuberculate, the tubercles coarser towards the proximal end; inner surface with a tuberculate ridge; palm with the upper portion turned abruptly inward almost at a right angle but without a sharp ridge; the upper surface is depressed and obscurely tuberculate, the tubercles becoming large and coarse near the union with the outer surface, which is crowded with granules which are smaller toward the tuberculate lower edge; there is a deep depression between the palm and pollex; the inner surface of the palm has a row of coarse tubercles extending from the lower margin obliquely upward and joining at right angles the row extending to the upper surface. The row of denticles or tubercles on the inner margin of the pollex is continued parallel to the base of the dactyl, and between this row and the dactyl there is an additional row; the irregular depression anterior to the oblique row is smooth and shining to the naked eye, but with the lens fine scattered granules may be seen near the gape of the fingers and continued on the pollex; pollex nearly twice as long as palm, almost straight, finely denticulate on the outer and inner margins of the prehensile edge, with a row of irregular tubercles between; distinctly two-toothed at the upturned extremity; dactyl overreaching

the pollex by about one-sixth of its length, slender, similarly armed within except that the irregular tubercles are prominent nearer the palm. Smaller cheliped with fingers much longer than palm. Ambulatory legs with meral joints wide, transversely striated, and hirsute near the base; remaining joints smooth; dactyls very slender. There are a few scattered hairs on the lower surface of the carapace, and a fringe of hairs on the inferior margin; the abdomen and sternum are also margined with very short hairs; otherwise the crab is smooth.

Length, 12.5; width, 20; length of large cheliped about 57 millimeters.

Horseshoe Bend, Colorado River, Lower California, U. S. Fish Commission steamer *Albatross;* one male (17459).

Family GRAPSIDÆ.

Subfamily GRAPSINÆ.

Pachygrapsus longipes.

One small specimen of a female with eggs is closely related to *P. plicatus* (Milne Edwards), but differs in the smoothness of the carapace. The anterior portion of the carapace and the margins are faintly plicated transversely, but without stiff hairs. The frontal lobes are well marked and the margin of the front is slightly convex. There is no tooth behind the postorbital. The chelipeds are covered with granules, arranged in irregular reticulations; there are several spines at the distal extremity of the merus and one sharp spine on the inner side of the carpus; a sharp longitudinal crest extends from the tip of the pollex back on the palm; the tips of the fingers are outlined with thick, bristly hair. The ambulatory legs have the meral joints transversely plicated, denticulate and hairy on the upper margin, lower margin with one or two spines near the distal end; remaining joints furnished with a few hairs, very slender; propodal joints much longer than in *plicatus* or *minutus*. Color in alcohol, green, mottled; legs striped with dark.

Length, 6.5; width, 8 millimeters.

Honolulu, U. S. Fish Commission steamer *Albatross*, 1891 (17320).

Brachynotus (Heterograpsus) jouyi.

Carapace much broader than long, nearly as wide at the orbital angles as at the last antero-lateral teeth; slightly convex in both directions; punctate, pubescent, and roughened with minute, spiny granules anteriorly and on the lateral margins. Front not advanced, deflexed, seen from above almost straight; seen from in front the margin has two small median lobes separated by a slight sinus, the remainder of the edge wavy. The superior orbital border slopes outward and backward to the base of the orbital tooth. Lateral teeth three, including the postorbital, prominent, acute, the first two similar, separated by a deep sinus, the third smaller, separated from the second by a shallower,

wider sinus. Terminal segment of the male abdomen much longer than wide, oblong. Chelipeds in male unequal; merus and carpus with fine granulated rugæ; palm broad, much inflated, finely granulate, not carinate, with a patch of hair on the inside extending from the carpus up on the pollex and in width occupying the central half of the palm; fingers very slightly gaping. Chelipeds in female very small; hands with a carina on the upper margin, and another on the outside near the lower margin. Ambulatory legs hairy, especially the fourth and fifth joints, rather slender; dactyls very slender.

Guaymas, Mexico; P. L. Jouy, February 29, 1891 (17496). "Gulf side, under stones, scarce."

Family PINNOTHERIDÆ.

Subfamily PINNOTHERINÆ.

Pinnixa occidentalis.

Carapace transverse, thick, hairy on the sides, surface uneven; on the cardiac region there is an acute, transverse crest, not interrupted in the middle as in *P. cylindrica* and *P. chætopterana*, but becoming lower and curving backward toward the center; regions well defined by pubescent sulci. Front narrow, median groove deep. A sharp ridge runs from the orbit diagonally outward and backward, crossing the hepatic region, and forms the antero-lateral margin of the carapace. Abdomen of male narrowing a little at the first suture, and gradually tapering from the second suture to the terminal segment, which is more than one-half as long as broad, and rounded. The female abdomen is very broad, the terminal segment much broader than in *chætopterana* or *cylindrica*. The second joint of the palpus of the external maxillipeds is somewhat oblong, tapering toward the distal end; terminal joint subspatulate, overreaching the preceding. Chelipeds stout, setose; merus thick, trigonal; palm broad, flat, shining on the outside; pollex short, bent downward, prehensile edge with a stout tooth in the middle and a small one near the tip; dactyl much curved, with sometimes a minute tooth in the middle. First pair of ambulatory legs shorter than the chelipeds, weak; second pair longer and stronger than the first; third pair very long and strong, especially the meral joint; fourth pair intermediate in length between the first and second; dactyli as long as the propodi. Ambulatory legs setose.

In the females the cardiac ridge is much less prominent than in the males, the fingers are less gaping or not at all gaping, the dactylic tooth is larger, and the teeth of the pollex are merged into one low denticulate prominence.

Length of largest male, 9.5; width, 19.5; length of third ambulatory leg, 27 millimeters; length of largest female, 10.5; width, 20.5; length of third ambulatory leg, about 24.

RECORD OF SPECIMENS EXAMINED.

From Iliuliuk Harbor, Unalaska, to Gray's Harbor, Washington; U. S. Fish Commission steamer *Albatross*, 1888–1890:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
2862	50 49 00	127 36 30	238	gy. S. P	44.7	17470
2868	47 52 00	124 44 00	31	gy. S	46.9	17471
2869	47 38 00	124 39 00	32	bk. S	48.4	17472
2870	46 44 00	124 32 00	58	rky	46.5	17473
3216	54 20 30	163 37 00	61	bk. S. M		17474
3311	53 59 36	166 29 43	85	gn. M	41.0	17475
3313	54 01 51	166 27 38	68	fne. bk. S	42.7	17476
3333	53 53 35	166 30 15	19	gn. M	43.9	17477

Alaska, W. H. Dall:

Locality.	Fathoms.	Bottom.	Cat. No.
Port Levasheff	20–30	M. Sh	17513
Port Levasheff	70–80	M. St	17514
Chajafka Cove, Kadiak	12–14	M. S	17512
Port Etches	12–18		17511
Sitka Harbor	15	Gr. M	17510

San Diego, California; H. Hemphill, one male, dried (17501).

Pinnixa californiensis.

The genus *Pinnixa* is represented on the coast of California by another species much resembling the one described above, but sufficiently distinct. The carapace is shorter, the cardiac ridge straighter throughout its length, the antero-lateral ridge straighter and less arched, and the carapace descends more abruptly at the sides. The front, orbits, and maxillipeds do not differ from those of *occidentalis*. The abdomen of the male has the margins of the second segment parallel, while in *occidentalis* the segment is wider at the distal than at the proximal end. In male specimens the pollex is shorter than in *occidentalis*, and consequently the dactyl is more nearly parallel with the end of the palm. The chelipeds in the female and the ambulatory legs in both sexes resemble those of *occidentalis*.

Length of ♂ 6, width 13; length of third ambulatory leg about 17.5 millimeters.

Monterey Bay and off Point Ano Nuevo, California, U. S. Fish Commission steamer *Albatross*, 1890:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3133	36 47 50	121 49 00	37	br. M	52.3	17478
3148	37 08 00	122 28 10	47	br. M	51.3	17479

Genus CRYPTOPHRYS.

Carapace no broader than long, hard. Front produced; orbits lodged in the sides of the front and very slightly visible from above. External maxillipeds not large enough to completely close the buccal cavity; ischium rudimentary; merus long and curved; palpus two jointed. Male abdomen with the second, third, and fourth articles coalesced. Chelipeds in male with palms broad, inflated. Ambulatory legs, with third, fourth, and fifth joints broad.

Cryptophrys concharum.

Male: Carapace subpentagonal, slightly longer than broad, smooth, rigid, a faint sulcus visible behind the gastric region. Anterior and antero-lateral margins defined by a ridge of coarse setæ, which are thickest and longest at the antero-lateral angles. Orbits circular, completely filled by the stout peduncles; antennulæ large, transverse. Abdomen broadest near the proximal end of the second segment; first segment short; coalesced segment with the first two of its component articles convex on the margin and separated by a faint line, and the last article slightly concave on the margin; third and fourth segments broader than long; terminal segment subrectangular. External maxillipeds having the merus curved on the outer margin, the distal portion almost transverse in position; the palpus articulated at its antero-external angle, two-jointed; terminal joint four-sided, much broader at the extremity. Chelipeds stout, margined with a row of coarse setæ, as are also the remaining legs; on the palm the upper row of setæ is on the inner surface just below the margin. First three pairs of ambulatory legs subequal, the second the longest; the fourth pair the shortest, overreaching the carpal joint of the preceding pair; dactyli about as long as the propodi, terminating in slender, curved hooks.

Length, 4.7; width, 4.2 millimeters.

False Bay, San Diego County, California; H. C. Orcutt, June 4, 1882; from mantle of *Mya arenaria* Linné, two males, one of which is very minute (17498).

Puget Sound, in *Cardita borealis* Conrad; two males, dried (17502).

In the alcoholic specimens the sixth and seventh abdominal segments are partially coalesced.

Genus SCLEROPLAX.

Carapace transverse, hard. External maxillipeds with ischium rudimentary; merus longer than broad, oblique, not curved, winged on the margins; palpus three-jointed. Ambulatory legs similar in character, slender, the third pair the longest, but slightly exceeding the others.

Scleroplax granulatus.

Carapace subpentagonal, hard, granulate anteriorly and near the margins, punctate elsewhere; a granulated ridge defines the lateral margin. Front narrow, produced, slightly convex as seen from above. Orbits nearly circular, eye-stalks very short and thick; antennules almost transverse. Merus of maxillipeds granulate, with a longitudinal, wing-like expansion on the inner margin, and another on the outer margin, which becomes narrower at the proximal end. Palpus triarticulate, large, the penult joint longer than the merus, the ultimate joint articulated near the proximal end of the inner margin of the penultimate and about equal in width to the adjacent portion of the penultimate; both joints are long, with a longitudinal median depression, and a fringe of very long hair bordering the extremities, the last joint slightly overreaching the other. Abdomen of female very smooth and shining, fringed with hair, not reaching beyond the sternum. Chelipeds in the female granulate, weak, shorter than the ambulatory legs; hands broad, somewhat compressed; dactyls strongly curved. Ambulatory legs slender, granulate, the third pair longest, the second longer than the first, the first pair weakest; the joints narrow, flattened; the dactyls are very slender, almost straight, and equal in length the propodal joints.

Length, 6; width, 8 millimeters.

Ensenada, Lower California, C. R. Orcutt; three females (17497). In the same vial is a fragment of a male, apparently the same species, in which the abdomen is narrow, tapering very gradually to the broad, terminal segment; third, fourth, and fifth segments partially anchylosed.

Subfamily ASTHENOGNATHINÆ.

Family Asthenognathidæ Stimpson, Proc. Acad. Nat. Sci. Phila., x, p. 107, 1858.

Resembling Pinnotherinæ, but the ischium of the external maxillipeds is longer and more distinctly developed. The last pair of ambulatory legs is not rudimentary or abortive. In this family are included the genus *Asthenognathus* and the following

Genus OPISTHOPUS.

Carapace usually firm and unyielding; smooth, subquadrilateral, regions not defined; lateral margins regularly arcuated. Epistome very short. Abdomen seven-jointed, in the male not covering the sternum between the coxæ of the last ambulatory legs. Eye-peduncles short. Antennæ small, situated at the inner orbital hiatus; basal joint small. Antennulæ obliquely plicated. External maxillipeds with the ischium well developed, the merus broad, the palpus three-jointed, the ultimate joint articulated on the inner side of the penultimate. Chelipeds moderate; ambulatory legs subequal in length, joints flattened.

Opisthopus transversus.

Carapace transverse, convex, thin, but not soft and yielding as in *Pinnotheres*, angles rounded. Front deflexed, almost straight when seen from above, with a slight median sulcus. Abdomen of male narrow at base, decreasing regularly in width to the seventh joint, which is subquadrilateral; abdomen of female very wide and long, almost covering the maxillipeds. Antennulæ well developed, lodged in deep, diagonal fossæ. Exterior maxillipeds with the ischium strong, broad; the merus as broad as long, with the antero-external angle broadly rounded; the palpus large; the ultimate joint narrow, inversely spatulate, overreaching the penultimate joint. Chelipeds rather stout; merus broad, trihedral; palm a little longer than the fingers, thick, slightly compressed, margins rounded, lower margin convex. Ambulatory legs similar in character; joints rather broad, except the dactyls, which are curved and small, a little more than half the length of the propodal joints: second pair of legs the longest, fourth pair the shortest, reaching midway of the propodal joint of the preceding pair.

Monterey, California; Dr. J. A. Canfield (3446); two males and two females, the females much larger than the males.

Point Loma, California; U. S. Fish Commission steamer *Albatross*, January 28, 1889; one female with eggs (17481).

Width of female, Monterey, 18; length, 14 millimeters. Width of female, Point Loma, 13; length, 11 millimeters; width of male, 9.8; length, 8.5 millimeters.

The front, appendages, anterior margin of the sternum, and the abdomen of the female, are fringed with hair. One female with eggs, from Monterey, is entirely covered with a short, dense sponge growth. The smallest male was found in the folds of *Lucapina crenulata* Sowerby.

Family CALAPPIDÆ.

Subfamily CALAPPINÆ.

Mursia hawaiiensis.

Carapace transverse, very convex in both directions, granulate, the granules becoming smaller on the tubercles, which are arranged in five more or less longitudinal rows, one of which is in the median line; lateral margins granulate, the antero-lateral also crenulate; lateral spine very short; carapace widest not at the base of the lateral spine, but in advance of that point; at each extremity of the posterior margin there is a flattened obtuse tooth; and midway between a faint projection or convexity of the margin. Frontal margin little produced, triangular, with three small teeth, the median more produced and depressed than the others. Orbits with a closed fissure above, and a deep rounded hiatus beneath; inner subocular lobe triangular; eyes oval, large, short-

stalked, filling the orbits. Subhepatic regions deeply channeled. Abdomen in male with five segments, the second with a thin, prominent trilobed crest, lobes minutely crenulate. Antennæ long; antennules oblique. Maxillipeds as in the genus. Chelipeds granulate, very unequal; large cheliped with three spines on the anterior portion of the merus, the inner very small, the outer the largest and of moderate length; hand not very deep, nine-toothed above; an irregular crest near the lower margin bears a sharp spine near the merus; small cheliped with merus one-spined; hand with about eleven small irregular teeth above; both hands have the lower margin spinuliferous. Ambulatory legs with granulated lines on the upper surface of the carpal joints.

The alcoholic specimen has tinges of red on the carapace and chelipeds and an elongated patch of red on the inner surface of the hand near the dactyl.

Length, in median line, 29; width, without spines, 36; length of lateral spine, measured on its posterior margin, 4 millimeters.

Off the Sandwich Islands, lat. 21° 12′ N., long. 157° 49′ W., 295 fathoms, fine white sand, station 3472, U. S. Fish Commission steamer *Albatross*, 1891; one male (17515).

This species is nearly related to *M. curtispina* Miers, but differs in the shorter lateral spines and the character of the hands; in *M. hawaiiensis* the hand is less deep, the crest more continuous and prominent, the sinuses of the upper margin narrower. The inner subocular lobe is regularly triangular and does not exceed the basal antennal joint, instead of being rounded, with a produced acuminate tip as in *curtispina*. The almost entire obsolescence of the median lobe of the posterior margin also distinguishes this species from *curtispina* and connects it with *armata* de Haan.

Platymera californiensis.

This species is closely allied to *P. gaudichaudii* from the coast of Chile. It agrees with Milne Edwards's brief description of that species,* but differs in many respects from the figure in d'Orbigny's Atlas.†

The antero-lateral teeth are smaller and are distinctly separated by broad, shallow sinuses. The tuberculous ridge on the palm is nearer the lower crest; the second and third teeth of the upper margin, counting from the carpus, are larger and stronger than in *gaudichaudii*. The ambulatory legs are narrower; this is especially noticeable in the fourth and fifth joints; the fifth joint of the first three pairs is not so distinctly granulate as in the figure. The external maxillipeds are granulate, especially the ischium, which has also strong irregular teeth on its inner margins. The raised portions of the carapace have a number of de-

* Hist. Nat. Crust., II, p. 108, 1837.

† Milne Edwards and Lucas, d'Orbigny's Voy. l'Amér. Mérid., atlas, Crustacés, pl. XIII, fig. 1, 1843.

pressed tubercles not mentioned in Edwards's description, but perhaps indicated in the figure by the red spots. There are three on the median line. In the young these tubercles are more prominent and the lateral and meral spines are proportionally much longer than in adults.

Milne Edwards says of *gaudichaudii* that the second ambulatory leg is longer than the first. In this series of specimens the two legs are very nearly equal in length, sometimes the first being a little longer and sometimes the second; this difference may occur on opposite sides of the same individual. The variation is due to the fact that, although the meral joint is always longer in the second pair, the carpal and terminal joints are always longer in the first pair; the propodal joints are more nearly equal, but when there is a difference, it is always longer in the first leg.

The characters above mentioned, which are constant in the hundred specimens examined, taken in connection with the great difference in habitat, are, I think, sufficient basis for the formation of a species.

Length of carapace, 64; width to base of spine, 95; length of spine, 14 millimeters.

Collected by the *Albatross* at the following stations off the coast of California:

Station.	Lat. N.			Long. W.			Fathoms.	Bottom.	Temperature.	Cat. No.
	°	′	″	°	′	″			°	
2918	32	22	30	119	03	30	67	fne. gy. S	52.4	16034
2921	32	27	00	119	14	15	145	fne. gy. S	51.5	16035
2922	32	27	15	119	05	15	47	fne. gy. S	57.1	16036
2953	33	47	00	119	58	15	82	gy. S. brk. Sh	....	16037
2956	33	57	30	120	18	30	52	fne. gy. S. R	53.1	16775
2969	34	20	40	119	37	45	26	gy. S. P. St	58.0	17167
2970	34	20	20	119	37	30	29	fne. gy. S. M	59.1	16038
2978	33	59	45	119	22	15	46	gy. S	56,5	16039
3100	37	43	20	122	43	00	29	crs. S	50.4	15609
3103	37	38	00	123	02	30	67	fne. dk. S	57.9	15607
3106	37	21	00	122	51	00	77	fne. gy. S	....	15605
3113	37	06	40	122	37	30	70	fne. gy. S	48.8	15606
3115	37	05	00	122	24	00	43	fne. bk. S	....	15604
3129	36	39	40	122	01	00	204	S. M	43.7	15608
3146	36	53	30	122	12	00	62	gn. M. R	49.5	15613
3147	37	00	00	122	20	00	56	br. M	49.2	15611
3148	37	08	00	123	28	10	47	br. M	51.3	15614
3204	36	54	45	122	20	15	202	bk. S	44.1	15612
3207	37	00	30	122	35	30	108	fne. gy. S	45.8	15603

One-half of the specimens collected are young. Station 3207 yielded the greatest number.

Family LEUCOSIIDÆ.

Subfamily ILIINÆ.

Ebalia americana.

Carapace longer than broad, suborbicular, convex; a distinct groove separates the cardiac, branchial, and intestinal regions; entire surface granular, the small granules crowded together, the large ones prominent, numerous, spiny; intestinal region oblique, very much rounded,

with a median tubercle pointing backward; on the posterior margin are two triangular obtuse, laminiform spines, the space between concave; on the posterior part of the branchial region, just above the margin, there is a stout, somewhat flattened, recurved spine. Frontal region without large granules; there is a cluster of granules at the summit of the hepatic region. Rostrum upturned, truncate. Male abdomen with third, fourth, and fifth segments coalesced, last segment long, triangular; female abdomen with fourth, fifth, and sixth segments coalesced, oval; abdomen and sternum in both sexes granulate. Orbits almost circular, with two fissures above and one below, besides the inner hiatus which is nearly filled by the obliquely-placed basal antennal joint. Antennular fossæ oblique. Ischium of external maxillipeds with a longitudinal row of large granules; exognath with large scattered granules, wide at the base, outer margin nearly straight, extremity rounded. There is a tubercle on the subhepatic region. Chelipeds in male about two and a half, in female about one and a half times the length of the carapace; merus subcylindrical with spiny granules; carpus and hand with flattened granules; hand compressed, fingers about two-thirds the length of the palm, not gaping, with granulate ridges, inner edges finely toothed and hairy. Ambulatory legs slender, granulate; meral joints cylindrical, of fourth pair with a row of spiny granules below; last three joints flattened; dactyls hairy.

Length, without posterior spines, 12.5; width, 11; length of cheliped, about 30 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1888–'89:

Station.	Lat. N.			Long. W.			Fathoms.	Bottom.	Temperature.	Cat. No.
	°	′	″	°	′	″			°	
2822	24	16	00	110	22	00	21	gy. S. brk. Sh	....	17386
2823	24	18	00	110	22	00	26½	brk. Sh	....	17627
3011	28	07	00	111	39	45	71	fne. gy. S. brk. Sh	57.9	17387
3014	28	28	00	112	04	30	29	gy. S	62.9	17388
3037	27	45	00	110	45	00	20	gn. M	65.2	17389

Myra townsendi.

Carapace oval-orbicular, granulate, the granules not close together, and on the gastric region few and indistinct; margin slightly concave behind the hepatic region; upper posterior spine at a right angle with the other two, longest; all three spines recurved; pterygostomian regions produced in a stout spine; frontal notch widely but distinctly V-shaped. Male abdomen with the third to the sixth segments anchylosed; first three segments granulate, remainder smooth; sternum granulate. In young males the abdomen is granulate for almost its entire length. Female abdomen with the fourth to the sixth segments anchylosed and oval; the first three segments and the margins of the anchylosed segment granulate. Anterior margin of buccal cavity with

a slight emargination. Antennular fossæ oval, slightly oblique. Merus of chelipeds not so long as the width of the carapace, subcylindrical, stouter through its proximal half, granulate, the granules growing smaller and less distinct near the carpus, which is minutely granulate, as are also the hand and dactyl; hand compressed, tapering a little toward the fingers, which are about the length of the palm, slender, bent downward, the outer margin of the pollex concave. Ambulatory legs with the merus joints cylindrical, fourth joint subcylindrical, fifth flattened, not dilated, cristate above; dactyls styliform, pubescent on the margins.

This species is very close to *Persephona*.

Length, without posterior spine, 32; width, 28; length of cheliped about 64 millimeters.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3017	29 54 30	113 01 00	58	gn. M	61.8	17381
3034	30 36 30	114 27 45	24	gy. M	63.5	17382
3035	30 21 00	114 25 15	30	gy. M	62	17383
3037	27 45 00	110 45 00	20	gn. M	65.2	17384

Myra subovata.

Carapace ovate-orbicular, longer than broad, granulate on margins and intestinal region with raised granules; remainder of surface smooth with scattered granules depressed in pits; lateral margin distinct; posterior median spine not sufficiently raised above the other two to form a right angle with them; spines triangular, recurved, median longest; posterior margin between the spines with large conspicuous granules; hepatic regions slightly swollen; pterygostomian regions unarmed. Male abdomen with the third to the sixth, and female abdomen with the fourth to the sixth, segments coalesced. Anterior margin of buccal cavity with a small U-shaped notch. Orbits slightly oblique. Outer margin of exognath of maxillipeds arcuate. Chelipeds slender, less than twice the length of the carapace, granulate, the granules largest on the proximal half of the merus, which is thicker than the distal half; merus subcylindrical; hand slightly compressed; fingers as long or longer than the palm, finely and sharply dentate within. Ambulatory legs slender throughout.

Dimensions of female: length, without spine, 22.7; width, 20; length of cheliped, about 40 millimeters.

Gulf of California; lat. 28° 28′ N., long. 112° 04′ 30″ W., 29 fathoms, gray sand, temperature 62.9°, station 3014; U. S. Fish Commission steamer *Albatross*, 1889 (17385).

Randallia distincta.

Carapace slightly longer than broad, orbicular, convex; sulci defining the regions distinct; antero-lateral margin behind the hepatic region slightly indented; entire surface granulate, the granules varying in size, larger posteriorly, somewhat clustered on the margins; three granulated tubercles on the margin of the anterior portion of the branchial region; one on the posterior portion; posterior marginal teeth stout, triangular; on the intestinal region there is a short recurved spine; hepatic region without a tubercle; pterygostomian region with a faint tubercle. Abdomen of immature female with fourth, fifth, and sixth segments coalesced, the sections distinct, however, as in the young of *ornata*. Rostrum two-lobed, the lobes high and ridged above; median groove deeper than in *ornata*. Orbit with two fissures above, with an intervening lobe, one fissure below, and an inner hiatus. Basal antennular joint forming an operculum which partly closes the fossa; basal antennal joint larger than the following joints, but not reaching the front. The anterior margin of the buccal cavity does not form the lower wall of the orbit. The maxillipeds do not cover the whole of the buccal cavity as in *ornata* and *granulata*, but leave an oval opening at the extremity of the exognath; endognath longitudinally ridged; ischium longer than the merus, with smooth inner margin; merus obliquely truncated at distal extremity, almost triangular; exognath nearly straight on the outer margin, extremity rounded, not reaching the end of the endognath. Chelipeds in the female nearly twice as long as the carapace, slender, granulate; merus cylindrical with granules spiny; hands narrow, slightly compressed, margins subparallel; fingers ridged, inner margins uneven, no gape. Ambulatory legs slender, granulate; dactyls hairy.

Length, 20.5; width, 20; length of cheliped, about 40 millimeters.

Off the Sandwich Islands, lat. 21° 12′ N., long. 157° 49′ W., 295 fathoms, fine white sand, station 3472; U. S. Fish Commission steamer *Albatross*, 1891; one immature female (17516).

Nursia tuberculata.

Carapace with posterior two-thirds very convex, densely set with circular tubercles, many of which are large, the space between them filled with smaller tubercles or granules of the same character; a median ridge extends backward from the frontal region to the cardiac region; intestinal region with a convex posterior projection somewhat bilobed. Antero-lateral margin with a slight convexity at the hepatic region, a broad lobe posterior to it followed by a denticle at the lateral angle. Postero-lateral margin tuberculate and slightly convex for its anterior half, concave for its posterior half, the intervening angle marked by a denticle. There is also a subhepatic denticle. Front truncate with a narrow median notch. Male abdomen broad, with the third to the fifth segments coalesced; penultimate segment with a

short appressed spine at its proximal end pointing backward. Inferior regions tuberculate, the tubercles of the abdomen and sternum much depressed. Chelipeds short, stout, tuberculate; merus cylindrical; carpus and manus with a thin superior crest; fingers almost as long as the palm, strongly deflexed, tuberculate at base, with fine teeth on the prehensile edges, fitting closely together; dactyl with a slight crest. Ambulatory legs tuberculate, except the dactyls, and hairy; dactyls long, slender and curved.

Length of carapace, 11.8; greatest width, 12.5 millimeters.

Gulf of California; lat. 29° 30′ N., long. 112° 40′ W., 45 fathoms; Lieut.-Commander H. E. Nichols, U. S. Navy, 1880–1882; one male, dried (17503).

Family DORIPPIDÆ.

Ethusa lata.

Carapace about as broad as long, covered with a velvety pubescence, interspersed with longer, curled hairs; a fringe of long hair borders the frontal margin and the outer orbital tooth; the cervical and cardiaco-branchial sutures are well marked; depression between the cardiac and gastric regions very deep but short. Front four-toothed, the median teeth more widely and deeply separated from each other than from the lateral. External orbital tooth large, triangular, not quite so much advanced as the front. Eye-stalks stout. Epistome very narrow. Bases of antennules moderately developed. Male abdomen five-jointed. Chelipeds in male very unequal, minutely pubescent; merus subtrigonal; carpus in larger cheliped suborbicular, produced internally in a rounded lobe; hand large, very broad, much inflated; fingers short and broad, irregularly denticulate on prehensile edges. Carpus of small cheliped in males and of both chelipeds in females, more elongate; hands small and narrow; fingers as long as the palm. Second and third pairs of legs very long, microscopically pubescent, dactyli much longer than the penultimate joints; fourth and fifth pairs densely pubescent and hairy, dactyli very short.

Length of male, 11; width, 11.5; length of second pair of ambulatory legs, about 34; of third pair, about 14.5 millimeters. Length of female, 11.8; width, 12; length of male, 7.2; width, 7.

In the smallest specimen, in which the length of the carapace is greater than the width, the median frontal lobes are more produced than the lateral, while the opposite is the case in larger specimens.

Gulf of California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
3013	28 23 45	111 58 00	14	gy. S. brk. Sh.	65.0	17482
3031	31 06 45	114 28 15	33	bu. M.	63.8	17483

Cymopolia fragilis.

Carapace very broad, ornamented with tubercles as follows: two large and broad on the frontal region; two small and broad directly behind these; four arranged almost transversely across the gastric region and separated by the mesogastric region, on which there are three in a triangle, and behind these two granules; across the cardiac region there is a prominent transverse ridge of four large tubercles, which is continued on the branchial region by an arcuate line of four smaller ones; between the penultimate tubercle of this row and the antero-lateral margin there are two small tubercles; there is a tubercle near the inner angle of the branchial region, and sometimes another exterior to it; also a depressed tubercle behind the orbit; there are two granules on the posterior portion of the cardiac region; the posterior margin is bordered by granules. The space between the tubercles is covered with short scattered setæ. Front four-toothed, the median lobes produced and near together, the lateral small. Supraorbital margin with two teeth. Antero-lateral teeth five, including the postorbital, the last two approximating. The inferior orbital border has two wide cuts; the inner lobe is itself two-lobed, with the outer lobe the larger. Sternum and abdomen finely pubescent; a ridge runs on the fifth sternal segment from the second abdominal segment to the coxæ of the fourth pair of legs; terminal segment of abdomen three-lobed. Chelipeds weak in both sexes, pubescent; carpus and manus obscurely tuberculate. Second and third pairs of ambulatory legs much exceeding the others, the second the longer, more than twice as long as the width of the carapace; meral joints of second and third pairs long, flattened below, with two dentate ridges above, the margins also dentate; carpal joints with smooth ridges; propodal joints with long hairs fringing the margins, the hairs lying flat upon the joints; dactyls with hairs upon the upper margin. First ambulatory leg a little longer than the width of the carapace, slender, obscurely ridged; fourth ambulatory leg very weak, about as long as the carapace.

Length, 8.5; width, 12.2; length of first ambulatory leg, about 13; of second, 25.5; of fourth, 8 millimeters.

Off Lower California; U. S. Fish Commission steamer *Albatross*, 1889:

Station.	Lat. N.	Long. W.	Fathoms.	Bottom.	Temperature.	Cat. No.
	° ′ ″	° ′ ″			°	
2983	28 58 30	118 15 45	58	gy. S. brk. Sh …	55. 8	17485
3011	28 07 00	111 39 45	71	fne. gy. S. brk. Sh.	57. 9	17486

Cymopolia zonata.

Carapace much narrower than in the preceding species, pubescent; protuberances arranged as in *fragilis*, but consisting not of single tubercles, but of clusters of many small tubercles or granules. Front four-

lobed, the median lobes rounded and inconspicuous, and separated by shallow notches from the broad lateral lobes. The upper margin of the orbit bears two triangular teeth; the outer angle is sharp and much produced. In addition there are two acute antero-lateral teeth projecting little beyond the marginal line, the outer edge of the teeth nearly straight. The posterior margin of the specimen is mutilated, but there can be discerned near the margin a transverse line of seven thin elongated tubercles; the margin itself is very minutely granulate, and between it and the tubercles the surface is granulate. The lower orbital border has two fissures and the inner lobe is two-lobed at the summit. Basal antennal joint little advanced. Sternum and abdomen finely pubescent; a transverse ridge on the fifth sternal segment; abdomen of male more tapering than in *fragilis;* margin of penultimate segment with an obtuse angle; terminal segment longer than broad, rounded, reaching the inner margin of the ischium of the maxillipeds. Chelipeds (the right one only is preserved) weak, tuberculate, pubescent; carpus armed with many irregular sharp-edged tubercles; hand broader than in *fragilis*, tubercles arranged longitudinally, the two rows on the upper surface the largest. Ambulatory legs of moderate length; first three pairs with a prominent tooth at the upper distal end of the meral joint; second and third pairs with a tooth near the upper distal end of the carpal joint; the meral ridges are formed by spiny tubercles; the carpal ridges are thin, prominent, and finely denticulate.

The specimen in alcohol is dark colored and mottled, and the legs have broad, transverse bands of dark and light.

Length, 9; width, 10.5; length of first ambulatory leg, about 11; of second, 18; of fourth, about 7.5 millimeters.

Gulf of California, lat. 24° 51′ N., long. 110° 39′ W., 40 fathoms, sand, broken shells, temperature 64°, station 2998; U. S. Fish Commission steamer *Albatross*, 1889; one male (17484).

NOTES ON SOME FOSSIL PLANTS FROM THE TRINITY DIVISION OF THE COMANCHE SERIES OF TEXAS.

BY

WILLIAM MORRIS FONTAINE.

(With Plates XXXVI-XLIII.)

The fossil plants whose description form the subject of this paper were collected by their discoverer, Mr. J. W. Harvey, of Glen Rose, Texas. They occur in the bed of the Paluxy River, two miles above Glen Rose. The material containing the fossils is a pretty firm limestone, quite free from sand and clay, and light gray in color, which was evidently a deposit formed at a considerable distance from the shore. This necessitated a prolonged immersion of the plant remains in water and their transportation over long distances. This conclusion, drawn from the nature of the sediment, is confirmed by the condition and character of the plant fossils. They are very fragmentary, and consist chiefly of types that can withstand maceration. The fact that the plant remains probably did not obtain speedy entombment in sediments must be taken into consideration in determining the probable character of the flora of the Trinity epoch, for the absence of certain types may be accounted for by the conditions attending the fossilization of vegetation.

The limestone is without minor structure planes and cleavage. It breaks in any direction, and this fact makes it difficult to work out, without additional comminution, the fragments preserved. An additional difficulty in securing identifiable specimens is caused by the fact that the vegetable matter of the fossils in many cases peals off from the stone, leaving an imprint that does not always give the true character of the relic.

Most of the fossils are in the form of small fragments. Cones of conifers and bits of twigs of the same much predominate. The twigs have usually thick leathery leaves and a dense durable epidermis. These facts indicate that the plants and parts of plants that can withstand long drifting are predominant, because more perishable forms were destroyed in transportation. Conifers of certain types are most common, probably because, under the existing conditions, they were best fitted for preservation, and not because they were most common in the flora. Plants fossilized after being drifted long distances can

never give so correct an idea of the flora of the time as those that are entombed where they fell. It is greatly to be desired that near-shore formations of the epoch now in question containing fossil plants may be discovered. In that case the absence of types in the fossils would more probably indicate their absence in the flora.

While the conditions under which they were preserved indicate that the Glen Rose fossils probably give us a very imperfect idea of the flora of the time, the amount of material obtained is not large enough to give us much confidence in any negative conclusions concerning the character of the Trinity flora. To this must be added the fact that the plants are obtained from a single very small area in all the vast expanse of the Trinity beds. The collection was contained in five quite small boxes. The greater part of the material is in the form of duplicates of a few types, and this shows that Mr. Harvey obtained as full a representation as was possible of the forms found at the locality.

Prof. Robert T. Hill, of the U. S. Geological Survey, established the subdivisions of the Lower Cretaceous of Texas now generally accepted, after determining the true order of succession of the formations of that great state. He gives for the Lower Cretaceous the following groupings, the Comanche series forming the base of the Cretaceous:

Comanche Series.	III. Washita Division.	10. Denison beds.
		9. Fort Worth beds.
		8. Duck Creek beds.
		7. Schloenbachia beds.
	II. Comanche Peak or Fredricksburg Division.	6. Caprina limestone.
		5. Comanche Peak beds.
		4. Walnut clays.
		3. Paluxy sands.
	I. Trinity Division.	2. Glen Rose or alternating beds.
		1. Basal Trinity sands.

In a letter to the writer, Prof. Hill states that the Glen Rose fossil plants occur in a lenticular mass of fine sediment, in a chalky lime mass full of marine fossils, about 250 feet above the bottom of the Trinity Division. According to him, there is no break between the basal Trinity sands and the Glen Rose beds. The latter represent deposits laid down in deeper waters farther from land. The Trinity basal sands were formed as the sea advanced from its present outline across the whole state of Texas.

Attention may here be called to the similarity in the conditions attending the formation of the Trinity beds and the Potomac beds, as found in Virginia, which latter hold a fossil flora nearly allied, in its older elements, to that of the Trinity. The Potomac beds of Virginia (the lower Potomac) contain the fossil plants in lenticular beds of clay which lie in the sands and other coarse materials, the clay beds representing eddies in the unquiet waters. The Virginia Potomac sands and gravels were laid down in shallow shore waters, in a progressing subsidence. But in the case of the Virginia beds we have no evidence that the subsidence was sufficient to produce limestone.

DESCRIPTION OF THE SPECIES.

EQUISETACEÆ.

Equisetum texense sp. nov.

Pl. XXXVI, Fig. 1.

Stems small, 3 to 4 millimeters in diameter. Average length of internodes, 1 centimeter. Sheath swollen, average length, 5 millimeters. Character of teeth not certainly made out, but apparently they are narrow and about twelve in number. This Equisetum is much like *E. Burchardti*, Dunker, of the European Wealden, and resembles also *E. virginicum*, of the Potomac formation, but it seems to have been somewhat larger than the latter. It belongs to the type of Equiseta with small stems and swollen sheaths that is characteristic of the Lower Cretaceous. These three plants, *E. Burchardti*, *E. virginicum*, and *E. texense*, are all closely allied and are, perhaps, somewhat varying types of the same species.

Only one specimen was found that showed the sheaths, and in this case the preservation was not perfect enough to make fully known the shape of the teeth. There are, however, several imprints which appear to have been made by portions of the stem of this plant. The tumid character of the sheaths, however, is well displayed in the more perfect specimen. The considerable length of this stem, its rigid nature, and the appearance of the sheaths, remind one of Casuarina.

FERNS.

One of the most peculiar features of the flora collected at Glen Rose is the almost total absence of ferns. Generally in any collection of older Cretaceous fossils ferns are among the most abundant forms. As these Texas fossils are preserved in sediment accumulated during a progressing subsidence, we would expect them to show a large proportion of ferns. This, however, is not the case. Only a single imprint, with its reverse, was found belonging to this group, and this is the tip of a pinna or pinnule, which is too small to permit the character of the plant to be made out.

Sphenopteris valdensis Heer?

Pl. XXXVI, Fig. 2.

A small specimen was found of a fern of Wealden type, closely allied to, if not identical with, *S. valdensis*, described by Heer from the Wealden of Portugal. The specimen is too small to permit the positive determination of the plant. The fragment seems to belong to the terminal portion of an ultimate pinna. As this portion of a fern often differs much from parts lower down on the pinna, it is of no value to

determine character. The pinnules or laciniæ have the narrow elongate shape, the oblique insertion, and the firm consistency given for *S. valdensis.* The nerves were not distinctly seen, but appear to be single in each lacinia or pinnule, as in the plant from Portugal. Heer* identifies his plant with *S. Jugleri*, Ettings, and with *Jeanpaulia nervosa* Dunk., of the Wealden of Hanover. This type of fern seems to have been a common one in the Wealden of Europe.

CYCADS.

The cycads, although not very abundant in the Glen Rose fossils, stand next to the conifers. They are in a very fragmentary condition, but still suffice to enable one to determine, in a number of cases, the character of the plant with some certainty. Fortunately the character of some of these forms is so marked that they are readily identified.

Dioonites Buchianus, var. **rarinervis** var. nov.

Pl. xxxvi, Figs. 3, 4.

This plant agrees in all respects, except the nerves, with the typical *Dioonites Buchianus.* It has the same thick durable epidermis, the same shape, dimensions, and mode of insertion of the leaflets, and the same character of stem. The nerves are stronger, fewer in number, and more remote than in the typical form so common in the Potomac of Virginia. They fork near the base of the leaflets, but have the ultimate branches only five to seven in number. Fig. 3 gives a portion of a leaf of medium size and shows the insertions of leaflets. Fig. 4 represents a terminal portion of a leaflet of large size showing the nerves. A considerable number (five to six) of specimens of this plant, were found, and if we may judge from this, it was one of the more common cycads of the Glen Rose region.

Dioonites Buchianus Schimper.

Pl. xxxvi, Fig. 5.

This plant, first found in the Carpathian Urgonian beds of Grodischt, and later seen to be distributed in great abundance in the Potomac strata of Virginia, was without doubt present in the Texas Trinity flora. It is, however, quite rare in the typical form as a fossil in the Glen Rose strata. At least two well characterized specimens of it, differing in no respect from the Virginia fossils, have been obtained. The specimens show the usual fine closely-placed nerves of the true *D. Buchianus*, covered with a firm durable epidermis. As I have endeavored in previous statements to show, no conclusion can be safely drawn from the rarity of the fossils as to the relative abundance of the form in the Trinity flora.

* "Flore fossile du Portugal," p. 14, Pl. xv, Figs. 9–14.

Dioonites Buchianus, var. **angustifolius** Font.

Pl. XXXVI, Fig. 6.

In the Potomac strata of Virginia a Dioonites was found with leaflets much narrower than the normal form. As it did not graduate into the normal *D. Buchianus*, and apparently was not an accidentally narrowed form of that species, the writer in Monograph XV of the publications of the U. S. Geological Survey, Part I, text, p. 185, proposed to consider it a variety. This narrow form is present in the Texas region, as is shown in one well characterized specimen. This specimen shows leaflets exactly like those of the Virginia Potomac.

Dioonites Dunkerianus (Göpp.) Miquel.

Pl. XXXVI, Fig. 12; Pl. XXXVII, Fig. 1.

Leaves large; midrib very strong; leaflets spreading, closely placed, somewhat thickened at base, slightly and gradually narrowed toward their bases; attached to the sides of the midrib, as in *D. Buchianus*, with a slightly protracted and decurrent base, narrowly linear in shape, obtuse to subacute at the tips, very thick and leathery in substance, with a firm durable epidermis, attaining apparently maximum length of 15 centimeters and a width of 2 to 3 millimeters; nerves obscure, apparently five to six in number, very slender, and immersed in the thick leaf-substance.

Several fairly well preserved specimens of this noteworthy plant were obtained. They apparently belong to the middle and upper portions of the leaf, and the basal and terminal portions were not seen. The specimens are somewhat distorted, so that the angle made by the leaflets with the midrib can not certainly be made out. They seem to go off at an angle of about 45 degrees.

This plant agrees so well with *D. Dunkerianus* (Göpp.) Miquel, from the Wealden of Hanover, that it can not be separated from it. It clearly belongs to the same genus with *D. Buchianus*, wherever that may be placed, but is decidedly distinct from it. Schenk, in describing* *D. Dunkerianus*, gives the length of the leaflets as 4 to 4½ centimeters. I do not understand how he obtained these dimensions, for on Pl. XV, Fig. 1, of the same work he gives a figure of this plant which shows leaflets 7 centimeters long with the entire length not preserved. That they were considerably longer is shown by the fact that a leaflet 7 centimeters long, with the end broken off, shows no diminution in width. Schenk's figure represents the leaflets as they are shown in the Texas plant. Fig. 1, Pl. XXXVII of this paper, gives a portion of a large leaf with the leaflets of only one side preserved. All of the width of the midrib is not preserved, but its great size is indicated in the specimen. Pl. XXXVI, Fig. 12, gives a specimen with a smaller midrib, showing its

* "Die Fossile Flora der Nordwestdeutschen Wealden formation," pp. 30, 31.

entire width. In this latter specimen a number of the leaflets attached to the right-hand side of the midrib are doubled over to the left-hand side, so that with casual inspection they might give an erroneous idea of their mode of insertion. The texture of the plant figured by Schenk seems to have been similar to that of the Texas form, for both show a wrinkling at right angles with the length of the leaflets, due to shrinking in drying.

It is very difficult to see the nerves, as they appear to be very slender and are immersed in the leaf-substance. The contraction produced in the fleshy leaflets gives sometimes deceptive forms. In some cases two longitudinal folds, near the center of the leaflets, appear as strong nerves, and sometimes the space between them takes on the appearance of a strong single nerve, giving the plant the appearance of a Cycadites. At first I was led to think that the plant belonged to this genus. I am not then surprised that Dunker* described a form of this plant as *Cycadites Morrisianus.* Schenk correctly unites it with *D. Dunkerianus*, notwithstanding the fact that Dunker's figure represents the leaflets as nearly 8 centimeters long with the ends not preserved.

Podozamites acutifolius Font.?

Pl. XXXVI, Fig. 7.

Only a single specimen was found of a plant that may be identical with *Podozamites acutifolius* Font., of the Potomac formation. This is represented in Pl. XXXVI, Fig. 7. It is the basal portion of a small leaflet, narrowing to a pedicel at base. It has quite fine nerves that fork towards the base, the branches becoming parallel. The size of the leaflet and its shape towards the base agree quite well with the Potomac plant,† but of course the specimen does not permit positive identification.

It should be stated that both the species here given as Podozamites may belong to the genus Nageiopsis as determined by the writer‡ from the Potomac flora. There are no characters in the basal portions of single detached leaflets that will distinguish the two genera. The tips of detached leaflets, however, show distinctions, for in Podozamites the nerves towards the ends of the leaflets converge and unite more or less, while in Nageiopsis they continue parallel but are usually more closely placed towards the tips.

With reference to the genus Nageiopsis, it may be stated that when its determination was made from the study of the abundant material obtained from the Potomac beds of Virginia, the writer had not been able to see specimens of the leaves of the Nageia section of Podocar-

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* "Monographie der Norddeutschen Wealdenbildung," p. 16. Pl. VII, Fig. 1.

† Monograph XV, U. S. Geological Survey, Part I, text, p. 181; Part II, plates, Pl. LXXXV, Fig. 10.

‡ Op. cit., Part I, text, p. 194–195.

pus. Descriptions of the leaves were relied upon. Since that, owing to the kindness of a friend residing in Japan, both the leaves and fruit of forms of Nageia have been procured. The leaflets in every respect are identical with those of Nageiopsis, while the nut-like fruits closely resemble some of the smooth, rounded forms described in Monograph XV, as Cycadeospermum. It will be noted that similar fruits are found in the Glen Rose fossils.

Podozamites species?

Pl. XXXVI, Fig. 8.

A single specimen of the basal portion of a leaflet was found among the Glen Rose fossils, which seems to be a Podozamites. The leaflet narrows to the base, as if to form a pedicel. The nerves are strong, fork near the base, then become parallel. They are rather remote, and may belong to a form like *P. distantinervis* of the Potomac of Virginia, but the leaflets are much smaller than any shown by that species.

Zamites tenuinervis Font.

Pl. XXXVII, Figs. 3, 4; Pl. XXXVIII, Figs. 1, 2.

A considerable number of specimens were found of a cycad not to be distinguished from *Zamites tenuinervis* Font. of the Potomac of Virginia. This is by far the most common cycad in the Glen Rose fossils, and it is noteworthy that it is decidedly the most common Zamites in the Potomac flora. As is the case with the Potomac fossils, the leaflets are found detached, showing that they were easily separated from the stem, leaving a base with a sinus. The only difference between the Texas and Virginia forms is found in the fact that some of the Texas leaflets show nerves rather more remotely placed than those seen in any of the Potomac forms. The curving shape found in some of the Potomac fossils may be seen in some of the Glen Rose forms also. Fig. 4, Pl. XXXVII, may be compared with Fig. 1, Pl. LXX of Monograph XV of the United States Geological Survey. Pl. XXXVII, Fig. 3, of this paper gives the end of a leaflet; Fig. 2 shows a portion of one of the broadest leaflets, and Fig. 1, Pl. XXXVIII, represents portions of three leaflets that were apparently attached to the same stem. This plant is pretty well characterized, and as it seems to have been well established in the Trinity flora it is important as showing a resemblance between that and the Potomac flora.

CONIFERS.

Conifers are, as stated before, predominant forms in the Glen Rose fossils. They predominate in the number of species, and especially in the parts of certain forms capable of withstanding long immersion in water. The twigs of such plants as Frenelopsis, covered with a dense epidermis, and those of Brachyphyllum, protected by their imbricated dense leaves, the compact cones of Pagiophyllum, and the thick

leathery leaves of *Sequoia pagiophylloides* are by far the most common fossils. The more fragile forms, like Sphenolepidium, Laricopsis, etc., are significant by their rarity. Owing to the fact that the parts of the plants were probably not covered with sediment as they fell, it is impossible to determine from the relative abundance of the fossils anything concerning the numerical relations of the plants in the flora.

Abietites Linkii (Roem.) Dunk.

Pl. XXXVII, Fig. 2.

The Glen Rose fossils furnish two or three specimens of a conifer that agrees closely with *Abietites Linkii* as described and figured by Schenk.* Schenk's figures represent detached leaves, but the Texas fossil is the end of an ultimate twig with several leaves attached. The exact mode of attachment of the leaves is not shown, but they, unlike the Cephalotaxopsis of the Potomac, a type somewhat similar to this, are scattered around the stem and taper gradually to their bases. The leaves are very rigid, coriaceous, linear in form, with obtuse tips. Only one good tip was seen, and the emarginate feature mentioned by Schenk was not observed. The midrib is single and strong. It is quite rare among the Glen Rose fossils.

Laricopsis longifolia Font.

Pl. XXXVI, Fig. 9.

A very distinctly defined imprint of a small cylindrical stem was found among the Glen Rose fossils. It has a distinct pitting, with small depressions that appear to be the scars of fallen leaves or leaf bundles. Attached to the stem which is proportionally very large, are the bases of several very narrow leaves. The leaves appear to have been thread-like. The stem and the leaves are exactly like some of those of *Laricopsis longifolia*, described by the writer from the Potomac of Virginia.† All the characters agree so well with those of the Potomac plant that, although the amount of the material is very small, I have no hesitation in regarding this Texas fossil as *L. longifolia*.

The nerves of the leaves could not be made out in the Glen Rose specimen, but there is nothing to indicate that they are not single in each leaf, as in the Potomac fossil.

Sphenolepidium Sternbergianum, var. densifolium Font.

Pl. XXXVI, Fig. 10.

Several specimens of a conifer were found that appear to be identified with *Sphenolepidium Sternbergianum*, var. *densifolium*. This variety was determined by the writer from the Potomac of Virginia.

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* "Fossile Flora der Nordwestdeutschen Wealdenformation," pp. 39, 40. Pl. XIX, Figs. 1-5.

† Monograph XV, U. S. Geological Survey, Part I, text, p. 233. Compare of the same work, Part II, plates, Pl. CLXVIII, Fig. 5.

The leaves of the Glen Rose plant, especially the lateral ones, are narrow, acicular, and incurved, all closely crowded. The Texas plants agree exactly with some of the Virginia forms,* resembling most those with the most delicate and crowded leaves. Some of the specimens show undeveloped leafy buds, as may be seen in some of the Virginia forms.† The specimens are few, probably because the parts of this plant could not withstand long immersion in water and transportation to a distance.

Pinus species?

Pl. XXXVI, Fig. 11.

The collection of fossils from Glen Rose contains a few scattered, linear, one-nerved leaves, such as are shown in Pl. XXXVI, Fig. 11. They are more attached, and are always so broken that only short bits are visible, which never show the tips of the leaves. They have a width of about 1½ millimeters, and the longest specimens have a length of about 3 centimeters. Their deciduous character, narrow, rigid form, with only one nerve, indicate that they are a species of Pinus which can not be at present more accurately determined.

Brachyphyllum texense sp. nov.

Pl. XXXVIII, Figs. 3-5; Pl. XXXIX, Figs. 1, 1*a*.

Trees or shrubs with alternate and penultimate branches in one plane, spreading rather widely. The ultimate branches are usually formed by the dichotomous forking, at considerable intervals, of the penultimate ones, but they are sometimes sparsely distributed alternately towards the terminations of the latter. The ultimate branches are short, stout, cylindrical in form, obtuse, not tapered towards their tips. All the branches were covered with closely imbricated, leathery, thick, scale-like leaves, which had a dense, very durable epidermis that in its present condition looks like enamel. The leaves vary a little in shape with age. The young leaves are broadly elliptical, the older ones broadly rhombic, less commonly more or less rounded. Nearly all the leaves had their ends prolonged into the form of a subacute, lancet-shaped tip, which is usually incurved in the lateral leaves. They are strongly keeled towards their ends, and the keel runs back in the body of the leaf some distance, but does not pass to its base. The leaves are often decussate, in four rows, but are sometimes spirally arranged.

The probable cones are narrowly oval to oblong, about 1 centimeter

* Compare Monograph XV, U. S. Geological Survey, Part II, plates, Pl. CXXXI, Fig. 3.

† *Ibid*, Pl. CXXXI, Fig. 1.

in thickness and $2\frac{1}{2}$ centimeters in length. The character of the scales of the cone was not made out. The probable staminate aments are oblong to cylindrical in form, covered with closely appressed and imbricated scales that are elliptical in shape and have at their ends acute prolongations that are about half as long as the body of the scale. These aments are about 13 millimeters long and 3 millimeters thick.

Numerous specimens of this noteworthy plant occur, and it was clearly very common in the Trinity flora. Unfortunately the thick coriaceous leaves have a great tendency to peel off from the stone, and hence specimens handled without great care are easily spoiled.

Pl. XXXVIII, Fig. 5, gives a portion of what was a branch of considerable size. It shows what seems to have been common in the plant, viz., the tendency of the twigs to diverge at first widely from the stems which give them off, and then to curve upwards toward the ends of the main branches. This figure shows also the dichotomous mode of division of the branches, which seems to have been the most common.

Pl. XXXIX, Fig. 1, represents the end of a compound branch that is much smaller than that given in Fig. 5, which is the middle portion of the branch.

In Pl. XXXIX, Fig. 1, the arrangement of the ultimate twigs in an alternate manner, a less common mode, is seen. Some of the ultimate twigs in this specimen were broken off, so that the ultimate grouping is not fully shown. The only cone found which can with probability be referred to this Brachyphyllum is that given in Fig. 3, Pl. III. As the stone in splitting carried off the upper surface of this cone the character of the scales was not made out, while its dimensions and shape are well disclosed. The scales seem to have been rather thick toward their free ends, wedge-shaped towards their base, and to have overlapped one another.

The small ament represented in Pl. XXXVIII, Fig. 4, most probably belongs to this Brachyphyllum, being the staminate ament. The shape of its scales agrees well with those figured by Saporta* for *B. gracile*, but the ament from Texas is more slender or cylindrical in shape.

This plant is most probably a new species. It is probably nearer *B. Moreauanum* Brongn., than any previously described species, but differs from this in the greater uniformity in the shape of the leaves, and in the constant absence of any mammillary prominence on their backs as well as in the more decided development of a lancet-shaped tip.

It is quite different from *B. crassicaule* Font., of the Virginia Potomac† in showing a more sparse dichotomous branching, in the distinct keel, in the denser epidermis of the leaves, and in their prolongation at their tips.

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*Paléontologie Française. Plantes jurassiques, Tome III; atlas, Pl. XLIII, Fig. 7.
†Monograph XV, U. S. Geological Survey, Part I, text, p. 221.

Pagiophyllum dubium sp. nov.

Pl. XXXIX, Figs. 2–11.

Tree or shrub, with the penultimate and ultimate twigs, which alone were seen, rigid, cylindrical, and quite thick. The leaves are slightly imbricated, or overlap by their tips, which are thin and parchment-like, while their bases are considerably thickened. They are closely appressed to the surface of the twigs, and show no keel or prominence of any kind. They vary much in shape, being broadly triangular or broadly elliptical, sometimes rounded subquadrilateral. All are very obtuse and rounded at their tips, and have their greatest dimensions transverse to the axis of the twig. The epidermis is thin, but apparently quite durable, and the outer surface of the leaves is marked by lines of pits which are distinctly visible to the unassisted eye, the lines converging toward the tips of the leaves, and being approximately parallel to their margins. These imprints are exactly like those seen on the epidermis of Frenelopsis, which is strikingly like that of the plant now in question. The cones, single or in pairs, at the end of short, very stout ultimate branches, are small and globular in form, the largest seen being about 15^{mm} in diameter, and the smallest 8^{mm}. The cone-bearing branches have, next under the cones, leaves of different character from the normal ones. They resemble much abbreviated points of *Frenelopsis varians*. They vary in shape from the normal kinds to those in which the edges of the leaves appear as transverse lines more or less convex upwards, and concave downward, only one rank of leaves appearing on the anterior surface of the stem.

The scales of the cones are closely appressed, small, numerous, spirally arranged, thickened at the free ends, prolonged into an incurving spiny beak like that of Araucaria. The beak being removed leaves a scar not unlike that of Araucaria, being a rhombic-shaped depression, much elongated transversely.

The scales of the cones, when wholly removed, as they generally are, leave imprints that are in shape subrhombic to broadly elliptical, and prolonged at the tips to a more or less acute point.

This remarkable conifer is the most common fossil at the Glen Rose locality. The twigs are not specially abundant, but the cones are very numerous, being much the most abundant fossil. They were borne on the summit of stout ultimate twigs, that generally broke off a little below the base of the cone, so that usually a short piece of the twig is found with each cone. Owing to the fact that the exterior of the fossils at Glen Rose is generally removed in breaking the stone, these portions of the twigs attached to the cones do not often show the character of the leaves. Still a considerable number of specimens are found with a few of the leaves pretty well preserved. Unfortunately none of the twigs attached to cones are long enough to show more than three or four leaves. Hence the character of the leaves on more remote portions

of the cone-bearing twigs was never seen, and the gradations of the abnormal leaves next to the cones into normal ones could never be traced on the same twig. But on comparing a number of these twigs it can be seen that there is a complete transition from the most abnormal forms to the normal ones. The leaves on most of the twigs next to the cones are so much like very much shortened internodes of *Frenelopsis varians* that for a long time I thought that the cones belonged to that species. This supposition was confirmed by the fact that this Frenelopsis has, in a number of cases, nodes on the stems that are much shortened. The likeness to Frenelopsis is increased by the presence of the lines of stomata, which much resemble those of that plant, and by the texture of the epidermis, which is similar to that of Frenelopsis.

The vegetable matter of the twigs of this plant is generally in the condition of a powder, inclosed in a shell composed of epidermal tissue. On breaking the stone the whole of the material crumbles away, and the exterior shell, showing the shape of the leaves, is especially prone to be destroyed. On this account it is very difficult to preserve specimens with leaves. Where the thin free tips of the leaves overlap on the thickened bases of those next above, pressure often produces the imprint of a line, so that some hint is thus given of the shape of the leaves. The imprints thus formed, however, do not give their true shapes, as the overlapping ends are not shown. Pl. XXXIX, Fig. 2, gives the shapes produced by these lines, and it will serve also to indicate the stoutness of the twigs, the one represented here being a penultimate one.

The leaves were proportionally very large, and of the general form of those of Brachyphyllum, but they do not possess the thick enamel-like epidermis of that plant. They have their basal portions thickened, and show very distinct rows of stomata. In these features they are allied to Pagiophyllum (Pachyphyllum) more closely than to any other previously described conifer, and on this account I have, with much doubt, placed the plant in that genus, indicating its doubtful position by the specific name given it. It is quite probable that the plant is the type of a new genus, nearly allied to Araucaria, and uniting in itself with features of Araucaria, some of those of Brachyphyllum and Pagiophyllum. The type seems to differ from Pagiophyllum chiefly in the form of the leaves. *Pagiophyllum* (*Pachyphyllum*) *cirinicum*, as described by Saporta,* agrees in its leaves on some of the larger twigs with this, but other forms of this species† have quite different leaves.

Indeed, the genus Pachyphyllum, renamed by Heer Pagiophyllum, although it can hardly be considered as sharply defined, has, as the more common form of leaf, one quite different from any shown in the

* Paléontologie Française, Plantes jurassiques, Tome III, Pl. LIII, Fig. 1.

† Ibid., Pl. LIV, Figs. 1-3.

plant now in question. While some leaves, as given by Saporta, have tranversely elongated, more or less rounded, or rhombic forms, they mostly appear with elliptic or rhombic shapes, elongated in the direction of the axis of the stem, with a considerable portion free, more or less remote from the stem, often incurving, with the whole leaf much thickened. This Texas plant does not have these features.

The leaves of *P. dubium* are very large in proportion to the diameter of the twigs, so that a single leaf often extends across the whole upper surface of the stem, as is shown in Pl. XXXIX, Figs. 3 and 4, which represent their more common forms. The cones are nearly always single, at the tips of short, stout twigs, but Pl. XXXIX, Fig. 5 gives a pair of cones, which appear at the summit of the twig. The shape and size of the cones of this plant remind one strongly of those of Sequoia. The resemblance is increased when the cone scales are retained, but have lost their beak-like projections. This sort of cone is shown in Pl. XXXIX, Fig. 6. Plate XXXIX, Fig. 7, shows the dimensions of one of the largest cones, and also the character of the imprints left when the cone scales are removed. This cone shows, at the summit of the twig which bears it, abbreviated leaves, such as are represented in Pl. XXXIX, Fig. 8, other cone-bearing twigs have such leaves as are given in Pl. XXXIX, Fig. 9. Figures 8 and 9 give magnified portions of the twigs. Plate XXXIX, Fig. 10 gives several leaves considerably magnified to show the lines of stomata. Plate XXXIX, Fig. 11 gives a twig to which a short cone-bearing twig is attached.

Frenelopsis varians sp. nov.

Pl. XL, Figs. 1–2; Pl. XLI, Figs. 1–3*a*.

Tree or shrub with penultimate and ultimate branches alone obtained. These were originally quite long, succulent, and cylindrical, with joints of varying length. The ultimate twigs seem to have played the part of leaves. The largest penultimate branches have a very small woody axis; the ultimate ones usually show little or no woody tissue. All the branches found fossil appear as flat, ribbon-shaped strips of vegetable matter, composed almost wholly of parchment-like, very durable, epidermal tissue, cut at varying intervals by lines of constriction which represent the nodes. The twigs are very prone to break at these nodes, hence they usually present the form of fragments without preservation of their summits and bases. The epidermis is marked by lines of dot-like imprints, which are not distinctly visible without the help of a lens. The internodes vary much in length and often irregularly, especially in the ultimate twigs. They sometimes appear uniformly short jointed, and then are exactly like *F. parceramosa** of the Potomac formation of Virginia, and from this cause I at first thought it identical with that plant. This uniformly short

* Monograph XV, U. S. Geological Survey, Part I, text, pp. 218–220.

jointed form is shown in Pl. XLI, Fig. 2. The most common form, however, shows internodes or joints averaging about 15 millimeters in length, except towards the base of the ultimate twigs, where, near their attachment to the penultimate twigs, they uniformly are much shortened, being 7 or 8 millimeters or less in length. These forms, which we may regard as the normal ones, have an average width for the joints of about 6 millimeters. This normal form is represented by Pl. XLI, Fig. 3. Other specimens, however, show great irregularity, the joints varying in length according to no rule, normal joints and short ones being intermixed. This is seen in Pl. XL, Fig. 1, especially in the right lower ultimate twig. The dimensions of the ultimate and penultimate twigs do not vary much. The ultimate twigs must, in some cases, have attained a considerable length, for fragments were seen 16 centimeters long, which did not have the ends preserved and did not show any marked diminution in diameter. The largest twig seen is a mere fragment, and is shown in Pl. XLI, Fig. 1. This shows the largest woody axis, for this axis appears to conform in size to the dimensions of the twig. The ultimate twigs seem to have been in their attachment to the ultimate ones rather remote and scattered around them. Some short twigs were found which seem to have been undeveloped ultimate twigs. One of these is represented in Pl. XL, Fig. 2. These forms show abbreviated nodes which strikingly resemble the leaves at the summit of the cone-bearing twigs of *Pagiophyllum dubium*.

The leaves are almost always undeveloped. The summits of the joints which should show the leaves, if they were present, almost always appear as a line of constriction which has various attitudes. It may run at right angles to the axis of the twig, or be inclined to it, in both cases being nearly straight. In other cases, and these are common, the constriction may be convex upwards or concave downward. These succeed one another in such order as to indicate that the ends of the joints bear undeveloped teeth or leaves of triangular type. In a very few cases there are very slightly developed teeth or leaves, which have the form of very broad, low triangles. This is shown in the form given in Pl. XLI, Fig. 3, where the right-hand lower ultimate twig, on the summit of the third joint from the attachment, shows a leaf of this kind.

The almost universal absence of developed leaves is one of the most important points of difference between this plant and *F. parceramosa*, for in this latter visible leaves are quite common, and of the character of those occurring with extreme variety in the Texas plant. It should be noted, however, that in the Potomac fossil a number of specimens show only the lines of constriction, as in the case of *F. varians*. The leaves when present appear to be one at the summit of each joint. While the Texas plant is most probably specifically distinct from *F. parceramosa*, it is very near to it, being nearer than to *F. Hoheneggeri* Schenk, of the Urgonian of Europe. This latter seems to be interme-

diate in type between *F. ramosissima** of the Potomac formation and *F. parceramosa*, since it has the considerable development of woody tissue, and the whorls of three leaves on the joints, possessed by the former, with the character of jointing and general aspect of the latter.

It is interesting to note that *F. parceramosa* occurs in the Potomac formation of Virginia in only one locality† in company with plants of a type strikingly like those associated with the Texas species. This locality is the "Entrance to Trent's Reach," on James River, where *Dioonites Buchianus*, *Brachyphyllum crassicaule*, *Williamsonia virginiensis*, etc., are also found. *Baieropsis pluripartita* was found at this locality, and it is probable that it will yet be found to exist in the Trinity flora.

F. varians is one of the most common fossils in the Glen Rose collection.

Frenelopsis Hoheneggeri (Ett.) Schenk.

Pl. XLII, Figs. 4, 4*a*.

The specimen given in Pl. XLII, Fig. 4, is the only one of the kind that was found in the Glen Rose fossils. It has all the characters of Schenk's plant, and differs decidedly from the numerous specimens of *F. varians*, among which it was found.

The specimens of *F. varians* are black in color, while this is brown. The twigs have a larger woody axis than that found in the more common plant. The tubercles are larger, so that the lines formed by them are distinctly seen with the unassisted eye, which is not the case with *F. varians*, and the general aspect of the twigs is more rigid. But more important than these features is the fact that the summits of all the joints bear distinctly developed leaves. These have the characters seen in *F. parceramosa* and *F. Hoheneggeri*, i. e., they are short and triangular in form. They differ from those of the former plant, and agree with those of the latter in the important feature that they occur in whorls of three. Two of these leaves occur on the upper face of the lowest joint of the specimen, and are represented in Pl. VII, Fig. 4*a*, which gives a portion of the stem enlarged to show the character of the leaves. The leaves alternate in position in the successive whorls, and resemble clearly those given by Schenk for *F. Hoheneggeri*.‡ The figure of this plant, given (Pl. VI, Fig. 1) in Schenk's work, shows on the second ultimate twig attached to the main stem on the left-hand side, counting from the bottom of the figure, a single triangular leaf, and on the joint next above these are two leaves of the same character that alternate in position with the one below. On the joint above these there is again a single leaf. This shows that the leaves of *F. Hoheneg-*

* Monograph XV, U. S. Geological Survey, Part I, text, pp. 215–218.

† Ibid., p. 220.

‡ "Die fossilen Pflanzen der Wernsdorfer Schichten." Pl. VI, Fig. 1.

geri occur, alternately in whorls of three. They, as given in this figure, agree exactly with those of the Texas plant.

On the specimen of the plant found at Glen Rose the epidermal tissues on nearly all the joints is too poorly preserved to show fully the leaves, but enough is preserved to indicate clearly that the plant has the character given above.

This Texas specimen has the rigid aspect which is characteristic of *F. Hoheneggeri*. It has much more woody tissue than larger specimens of *F. varians*, and shows no short joints.

Sequoia pagiophylloides sp. nov.

Pl. XLII, Figs. 1–3*a*.

Tree or shrub with the penultimate and ultimate branches spreading in one plane, the latter alternate in position. Leaves on the older branches spirally arranged so as to appear as facial and lateral in position. The facial leaves are inconspicuous, sparsely scattered, closely appressed to the stem, and much smaller than the lateral ones. They are lancet shaped or elliptical, rounded at the tips, and very obtuse, with no keel or midrib. The lateral leaves are much larger and form the only conspicuous ones. They are, as now presented, oval or triangular in shape, rather remote, with a much broader base, strongly decurrent, and stand nearly at right angles with the axis of the twig. They are very obtuse at the summit, and are slightly falcate in their upper portion. The leaf substance is very thick and is covered with a dense, firm, and durable epidermis. They have a distinct keel or midrib, which toward the summit is much attenuated, but toward the base is widened, so as to assume a triangular form. The younger twigs show only lateral leaves, which are similar to those on the older ones. The probable staminate aments, of which only one specimen was found, occur on a common stem arranged alternately. They are very small, being club or pear shaped, with a maximum thickness at the summit of about 2 millimeters, and a length of about 3 millimeters. They are not preserved well enough to show the details of structure, but appear to be covered with thin, rounded scales. That they belong to this plant is shown by the presence of a normal lateral leaf between two of the aments, the two lowest on the left-hand side.

Fig. 1, Pl. XLII, shows one of the most complete branches of this plant that was found, and Fig. 1*a* gives a magnified portion of the main stem of this specimen to show the facial leaves. These do not generally appear, as they are destroyed in splitting the stone by the peeling off of the epidermis. Pl. XLII, Fig. 2, gives a specimen with lateral leaves of the largest size, and which shows no facial leaves. Fig. 2*a* gives a portion of this enlarged to show the character of the lateral leaves. Fig. 3, Pl. XLII, gives the group of aments of natural size, and Fig. 3*a* gives a portion of it enlarged to show the normal lateral leaf.

This fossil is one of the most common ones at Glen Rose. This is no doubt accounted for by the very durable character of the epidermal tissue and the thick character of the leaves. They are very prone to peel off from the stones and leave only an imprint. The lateral leaves appear now as a leathery material, composed mainly of the epidermis. This has in the center a sharply defined keel, that looks like a pucker in the leaf substance, rather than a bundle of woody tissue forming a true midnerve. The keel, however, is probably determined by the presence of such a midnerve influencing the shrinking of the leaf tissue in drying. No vascular bundle, however, was distinctly seen, and in this respect the leaves differ from those of Sequoia, and resemble more those of Pagiophyllum. It is difficult to determine from the present aspect of the leaves what was their character when living. They, however, give strong indications that they were much thickened towards their bases, so as to have a pyramidal form, and they probably had a distinct keel, so that their cross-section would be rhombic in form. This again is a character of Pagiophyllum and not of Sequoia. But in Pagiophyllum, as a rule, the facial leaves are numerous and as conspicuous as the lateral ones, while in this plant they do not appear at all on the ultimate and youngest twigs, and on the older ones they are so few, small, and closely oppressed that they are not visible unless carefully looked for. It was only after prolonged search that I found a specimen showing them. It is true that allowance must be made for the greater liability of the facial leaves to be destroyed in splitting the stone, but a number of specimens showed the outer surfaces of the ultimate twigs well preserved, and in no case were facial leaves shown even in traces.

I have with great hesitation placed this plant among the Sequoias, to which it has, in general facies, a strong resemblance. It shows a blending of the features of that genus and of Pagiophyllum, and is probably a new genus with composite character, as is the case with the peculiar *Pagiophyllum dubium*. The data at hand, however, do not suffice to fix with certainty its true character, and it may be provisionally regarded as a Sequoia. The large angle that the lateral leaves make with the stem is totally unlike Pagiophyllum, and more resembles Sequoia, although no previously described species of this genus known to me has leaves standing so nearly at right angles with the stem. *Sequoia ambigua* is nearest to it, but its leaves have a distinct vascular midnerve, are much thinner in texture, and more acute, while they go off more obliquely.

Abietites species?

Pl. XLIII, Fig. 4.

This undetermined cone is too fragmentary to permit its character to be made out, but enough is preserved to show that it was considerably larger than any of those of Brachyphyllum and *Pagiophyllum dubium*. The axis is thick and woody, the scales appear to have been long and wedge-shaped, thin at their lower ends and thickened at their upper end

The cone seems to have been broadly elliptical in form, about 2½ centimeters long and 2 centimeters thick. The stout stem, still attached to the base of the cone, does not show any of its external surface, so that the leaves can not be made out. In size and shape it reminds one of *Abietites angusticarpus* of the Potomac of Virginia.*

PLANTS OF UNCERTAIN AFFINITY.

Williamsonia texana sp. nov.

Pl. XLIII, Figs. 1, 2.

The bracts are arranged in two alternating whorls, four or five in each whorl, at the summit of apparently a large woody stem. They are lancet shaped to narrowly ovate, about 15 millimeters long and 4 millimeters wide in the widest portion, smooth, and with no nerves apparent. Plate XLIII, Fig. 1, shows some of the leaves at the summit of a small stem. Plate XLIII, Fig. 2, shows a portion of both whorls somewhat contorted, while the stem is only partially given.

This is apparently a new species of Williamsonia. It differs from *W. virginiensis* of the Potomac of Virginia† in being smaller, thinner in texture, smoother, and in not showing hairs. The shape of the bracts is similar to that of the two forms given by Schenk as found in the Wernsdorf beds,‡ and which he thinks are the male inflorescence of some cycad, but the stem of the latter, especially its summit, is quite different. This adds another to the similar types of plants found at Glen Rose and the entrance to Trent's Reach in Virginia.

Carpolithus obovatus sp. nov.

Pl. XLIII, Fig. 5.

Several specimens were found. This seed is somewhat altered from maceration. It shows pretty strong ridges, but has been decorticated, so that its original exterior can not now be made out. There appears at its lower end an indication that it was attached to a strong stem. It has an obovate shape, being widest near the summit, where it seems to have borne a short beak. In the widest portion it measures 14 millimeters, while the length is 3 centimeters. It seems to have had a large amount of woody tissue.

Carpolithus Harveyi sp. nov.

Pl. XLIII, Fig. 3.

Only one specimen was found. The seed seems to have had a smooth surface and a large amount of woody tissue, so that the entire form is now preserved in lignite. Its shape is elliptical, with one margin more

* See Monograph XV, U. S. Geological Survey, Part II, plates, Pl. CXXXIII, Fig. 1.

† Monograph XV, U. S. Geological Survey, Part I, text, p. 273; Part II, plates, Pl. CXXXIII, Figs. 5–7; Pl. CLXV, Fig. 5.

‡ Die fossilen Pflanzen der Wernsdorfer Schichten, Pl. V, Figs. 3, 4.

convex than the other. In the widest part it measures 13 millimeters, while the length equals 2½ centimeters. It is very much like *C. curvatus** of the Virginia Potomac, the only difference being that it is not so much curved as that. Named for Mr. J. W. Harvey, the collector.

Cycadeospermum rotundatum Font.

Pl. XLIII, Fig. 6.

Several specimens of this were seen. The seed was spherical in form and covered with a smooth parchment-like durable epidermis, which looks like brown enamel, and is often all that is preserved. It is about 8 millimeters in diameter. It is exactly like the seed of the same name found in the Potomac of Virginia,† but is more strictly globular in form, a difference that is probably due to different effects of pressure.

AGE AND AFFINITIES OF THE TRINITY FLORA.

A typical Mesozoic flora is composed of only four elements. These are ferns, cycads, conifers, and equiseta. The flora of this type seems to have reached its culmination in the Jurassic, but many of its plants were continued with diminishing numbers through the Lower Cretaceous, ending with that epoch. The Wealden of different parts of the world appears to have been the fresh-water and marsh equivalent of the lower portion of the Neocomian, which, in its typical development, represents the marine deposits of the Lower Cretaceous. The typical Wealden contains no element in addition to the four given above, but the lower Potomac formation, as seen in Virginia, appears to coincide in age with the greater part of the Neocomian, and this gives us, so far as is yet known, the first appearance of angiosperms. The older portion of the lower Potomac contains, with a great predominance of Jurassic types, a number of old forms of angiosperms, such as Ficophyllum, Proteæphyllum, Rogersia, etc. In the upper beds of the same angiosperms become more abundant and they are more modern in type, while the Jurassic element is much diminished. The plants found at Glen Rose, show, so far as can be judged from so imperfect a collection, that the Trinity flora finds its closest resemblance in the older portion of the lower Potomac. There is, however, this important difference: No trace of angiosperms, even the most archaic, has been found in the Texas region. We have only the four elements of the typical Jurassic flora. This then makes the Trinity flora somewhat older than that of the oldest Potomac. The absence of the angiosperms and the presence of the forms that are found indicate decidedly that the Trinity flora is not younger than the earliest stage of the Cretaceous. The number of

* Monograph XV, U. S. Geological Survey, Part I, text, p. 269; Part II, plates, Pl. CXXXV, Fig. 17.

† Monograph XV, U. S. Geological Survey, Part I, text, p. 271; Part II, plates, Pl. CXXXVI, Fig. 12.

plants found to be identical with certain of those of the oldest Potomac shows that there is little difference in the age of the two formations. The plant-bearing portion of the Trinity is somewhat older than the basal Potomac strata, but the difference in age can not be great.

There can be little doubt that additional collections from the Trinity strata will show at least some of the older forms of angiosperms found in the Potomac, but at present they are not known to exist. It will be convenient, for the purpose of comparison, to give in the form of a table the plants found at Glen Rose. In it the plants will be placed in the formations in which they have been previously found, and where similar, but not identical, species have been previously known they will be indicated in the proper formation. In the first column the peculiar species, or those that occur only at Glen Rose, will be placed.

Table of Glen Rose fossils.

Name.	Peculiar species.	Occurring in the Potomac formation.	Occurring in the Wealden formation.	Occurring in the Urgonian formation.
1. Equisetum texense	....	Near Equisetum virginicum.		
2. Sphenopteris valdensis?	....	....	+	
3. Dioonites Buchianus var. rarinervis	....	Near Dioonites Buchianus.	....	Near Dioonites Buchianus
4. Dioonites Buchianus	....	+	....	+
5. Dioonites Buchianus var. angustifolius	....	+	+	
6. Dioonites Dunkerianus	....	....	+	
7. Podozamites acutifolius	....	+		
8. Podozamites species?	....	Near Podozamites distantinervis.		
9. Zamites tenuinervis	....	+		
10. Abietites Linkii	....	....	+	
11. Laricopsis longifolia	....	+		
12. Sphenolepidium Sternbergianum, var. densifolium.	....	+		
13. Pinus species?	+			
14. Brachyphyllum texense	....	Near Brachyphyllum crassicaule.		
15. Pagiophyllum dubium	+			
16. Frenelopsis varians	....	Near Frenelopsis parceramosa.		
17. Frenelopsis Hoheneggeri	....	....	....	+
18. Sequoia pagiophylloides	+			
19. Abietites? species	+			
20. Williamsonia texana	+			
21. Carpolithus obovatus	+			
22. Carpolithus Harveyi	....	Near Carpolithus curvatus.		
23. Cycadeospermum rotundatum	....	+		
	6	6 similar. 7 identical.	4	1 similar. 2 identical.

From this table it will be seen that all the species of the Glen Rose fossils hitherto found occur in the Lower Cretaceous, ranging from the Wealden to the Urgonian. The Potomac includes both these epochs. Some of the fossils from Glen Rose have no value for the fixing of the age of the flora because they are not sufficiently well characterized. Of such a nature are *Sphenopteris valdensis?*, the undetermined species of Podozamites, the species of Pinus, and the undetermined cone. Omitting these, we have nineteen species. Four of these are peculiar species, and they of course can not be taken into consideration when the Trin-

ity fossils are compared with known plants. Of the fifteen remaining, no less than twelve are identical with plants from the older Potomac, or are so near them that a strong presumption of the nearness in age of the two formations is established. The circumstances under which the basal Trinity beds were laid down indicate that the fossils entombed in them form a portion of a flora that was established on the land that was enroached upon by the Trinity sea. It is probable that this same flora extended northward to Virginia, where, somewhat later, it was preserved by a similar encroachment.

The Glen Rose, or alternating strata, in which the fossil plants are found, contain an abundant marine fauna, from the evidence of which Prof. Hill had concluded that its age is Neocomian, or basal Cretaceous. No fossil plants had been hitherto found in the Comanche series, and the evidence of its age was derived wholly from the animal remains. The discovery of plants in it was then of special importance, for it enabled us to compare the evidence of the plant life with that of the animal life. It is interesting to find so close an agreement. This agreement adds one more proof of the value of fossil floras in fixing the age of the strata in which they are found.

EXPLANATION OF PLATES.

PLATE XXXVI.

Fig. 1. *Equisetum texense* sp. nov.
Fig. 2. *Sphenopteris valdensis* Heer. ?
Figs. 3, 4. *Dioonites Buchianus*, var. *rarinervis* var. nov.
Fig. 5. *Dioonites Buchianus* Schimper.
Fig. 6. *Dioonites Buchianus* var. *angustifolius* Font.
Fig. 7. *Podozamites acutifolius* Font. ?
Fig. 8. *Podozamites* sp. ?
Fig. 9. *Laricopsis longifolia* Font.
Fig. 10. *Sphenolepidium Sternbergianum* var. *densifolium* Font.
Fig. 11. *Pinus* sp. ?
Fig. 12. *Dioonites Dunkerianus* (Göpp.) Miquel.

PLATE XXXVII.

Fig. 1. *Doonites Dunkerianus* (Göpp.) Miquel.
Fig. 2. *Abietites Linkii* (Roem.) Dunk.
Fig. 3, 4. *Zamites tenuinervis* Font.

PLATE XXXVIII.

Fig. 1, 2. *Zamites tenuinervis* Font.
Figs. 3–5. *Brachyphyllum texense* sp. nov.

PLATE XXXIX.

Fig. 1, 1*a*. *Brachyphyllum texense* sp. nov.
Figs. 2–11. *Pagiophyllum dubium* sp. nov.

PLATE XL.

Figs. 1, 2. *Frenelopsis varians* sp. nov.

PLATE XLI.

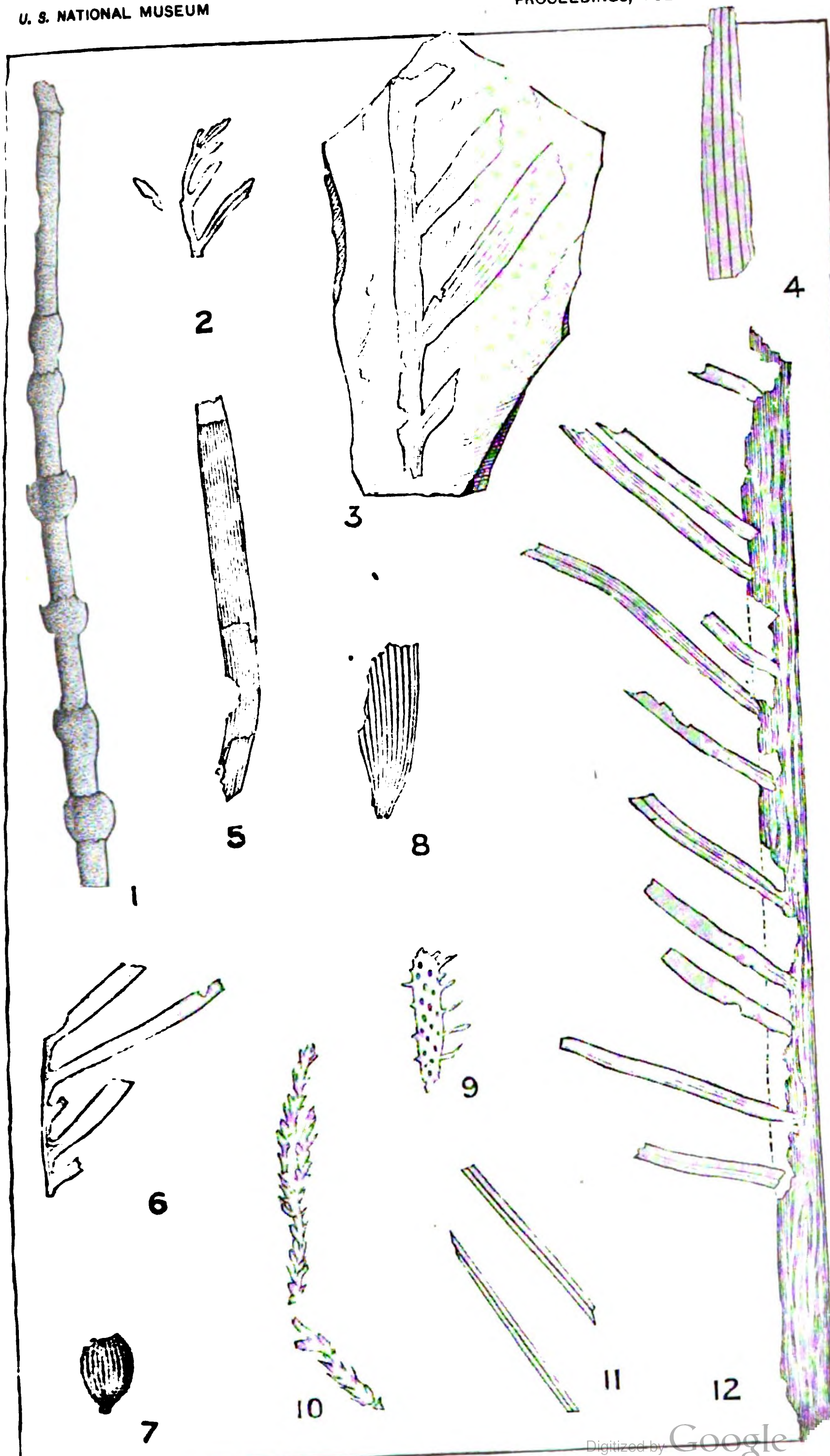
Figs. 1–3a. *Frenelopsis varians* sp. nov.

PLATE XLII.

Figs. 1–3a. *Sequoia pagiophylloides* sp. nov.
Figs. 4, 4a. *Frenelopsis Hohenggeri* (Ett.) Schenk.

PLATE XLIII.

Figs. 1, 2. *Williamsonia texana* sp. nov.
Fig. 3. *Carpolithes Harveyi* sp. nov.
Fig. 4. *Abietites* sp. ?
Fig. 5. *Carpolithes obovatus* sp. nov.
Fig. 6. *Cycadeospermum rotundatum* Font.



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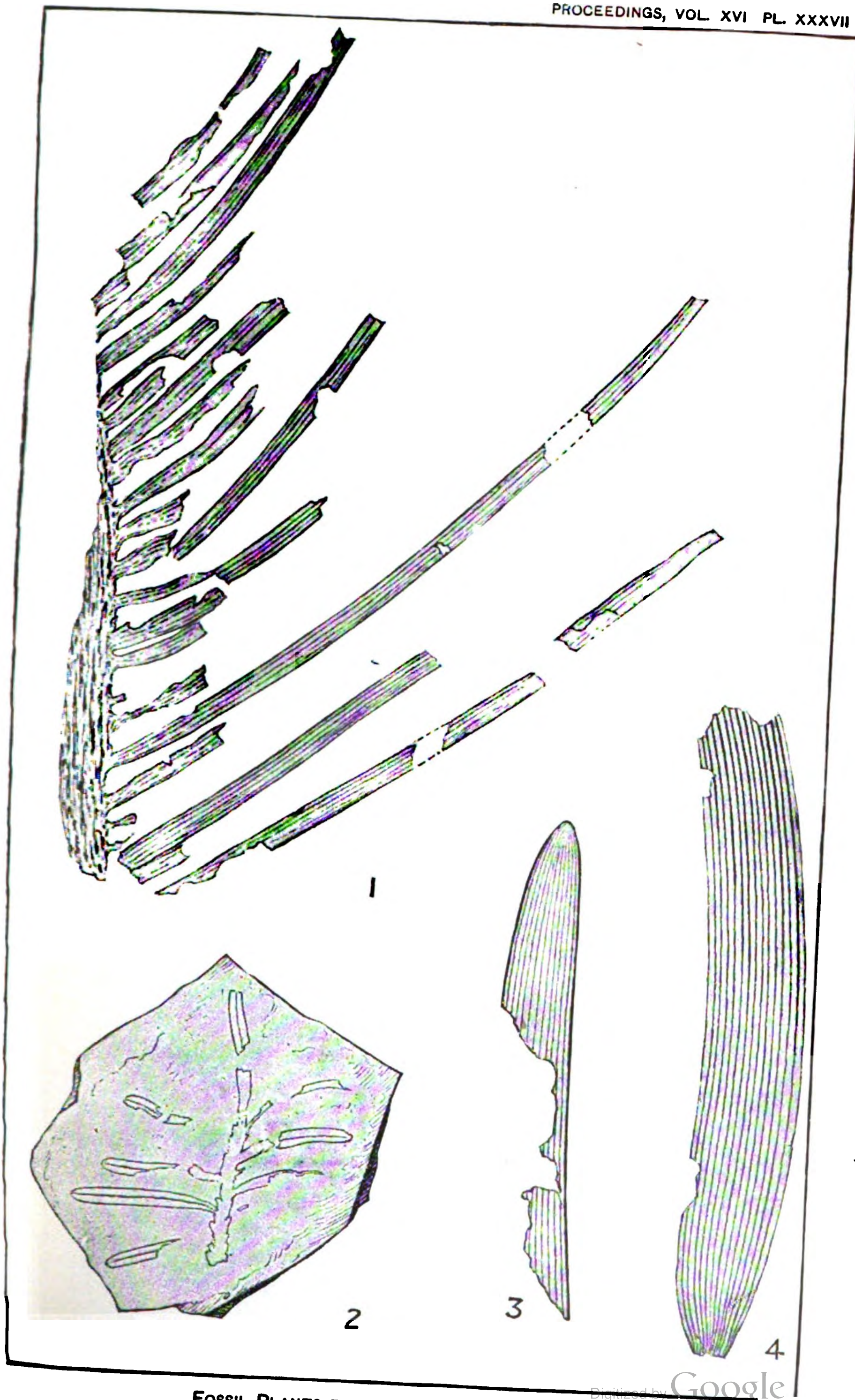

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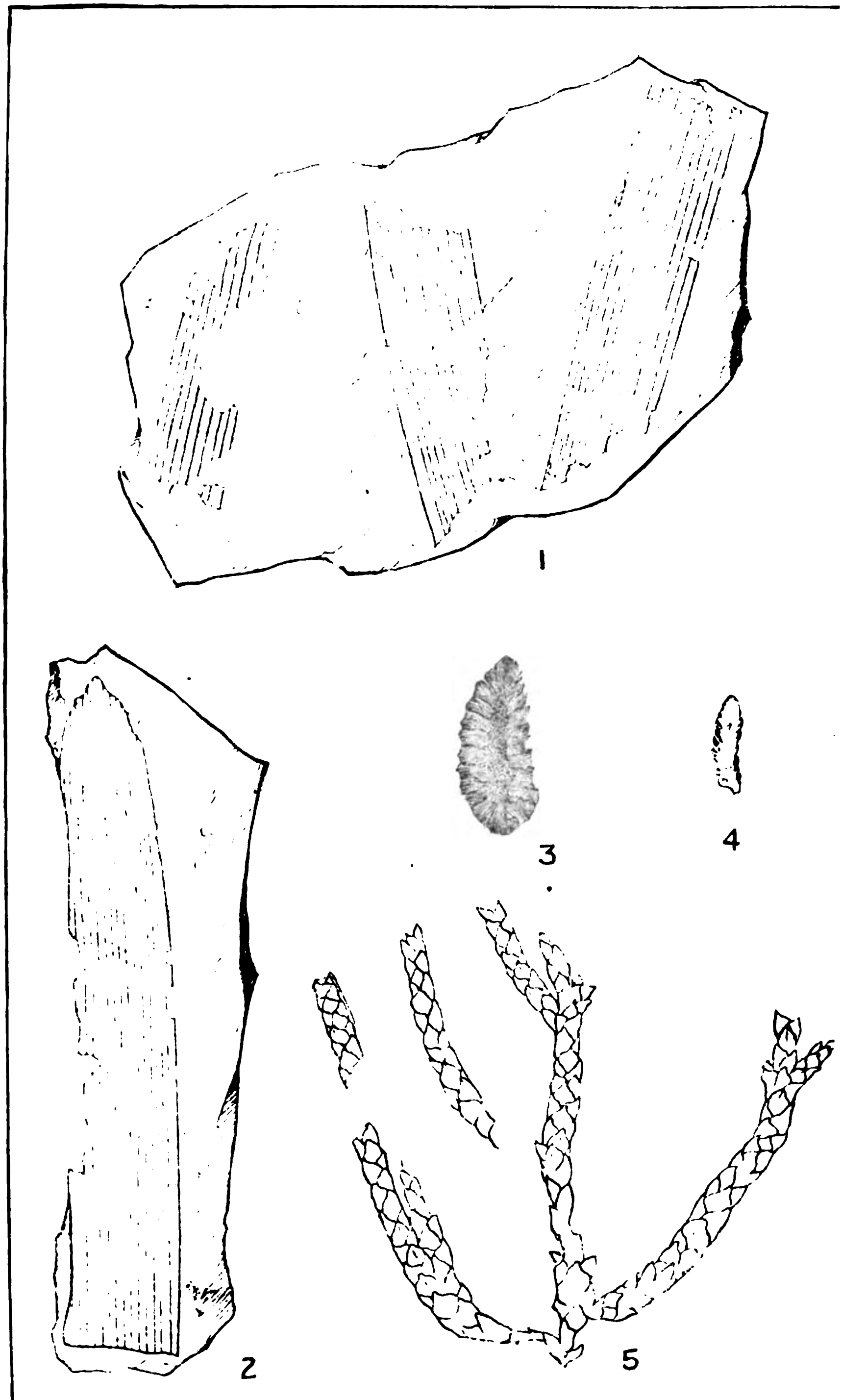

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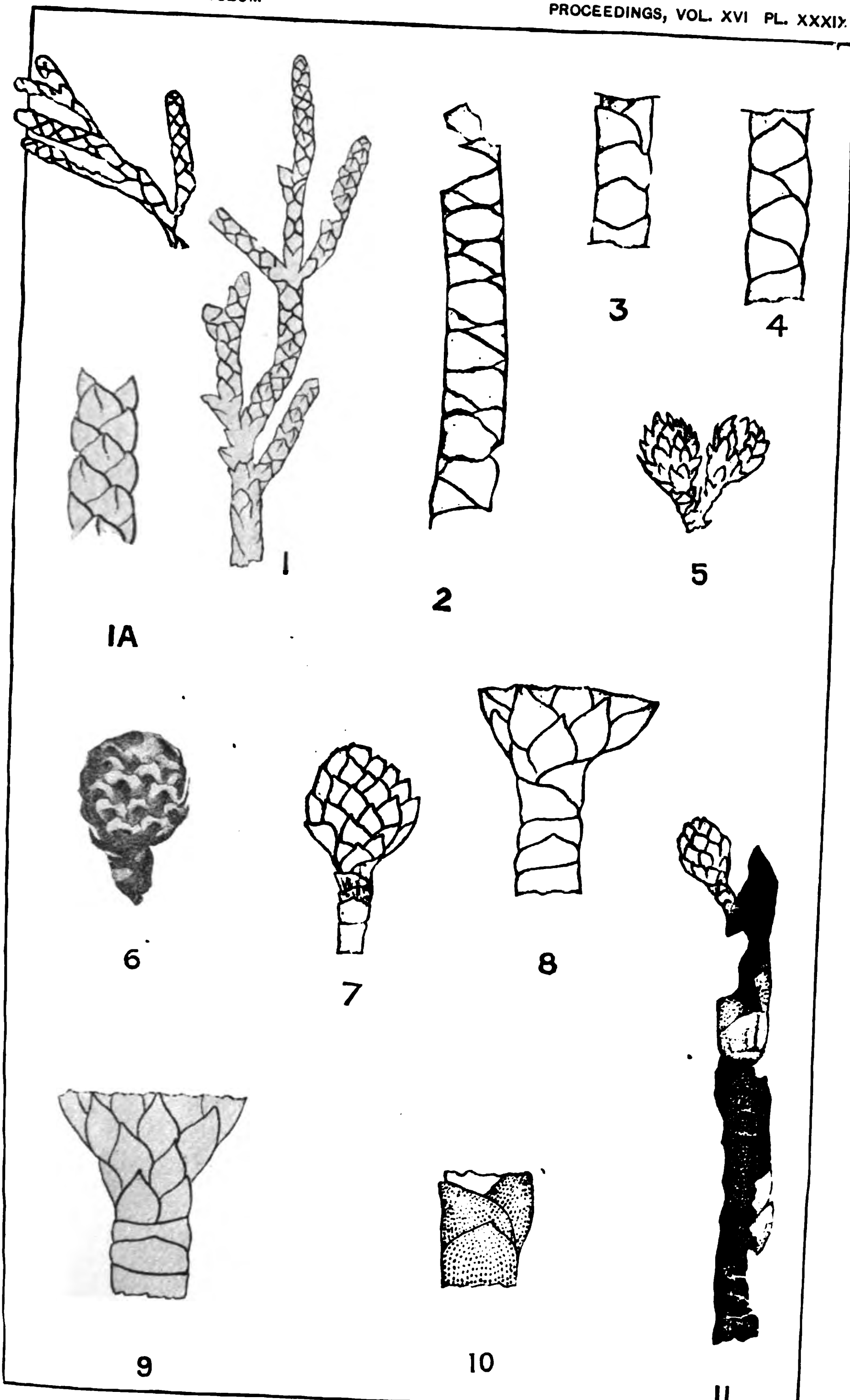

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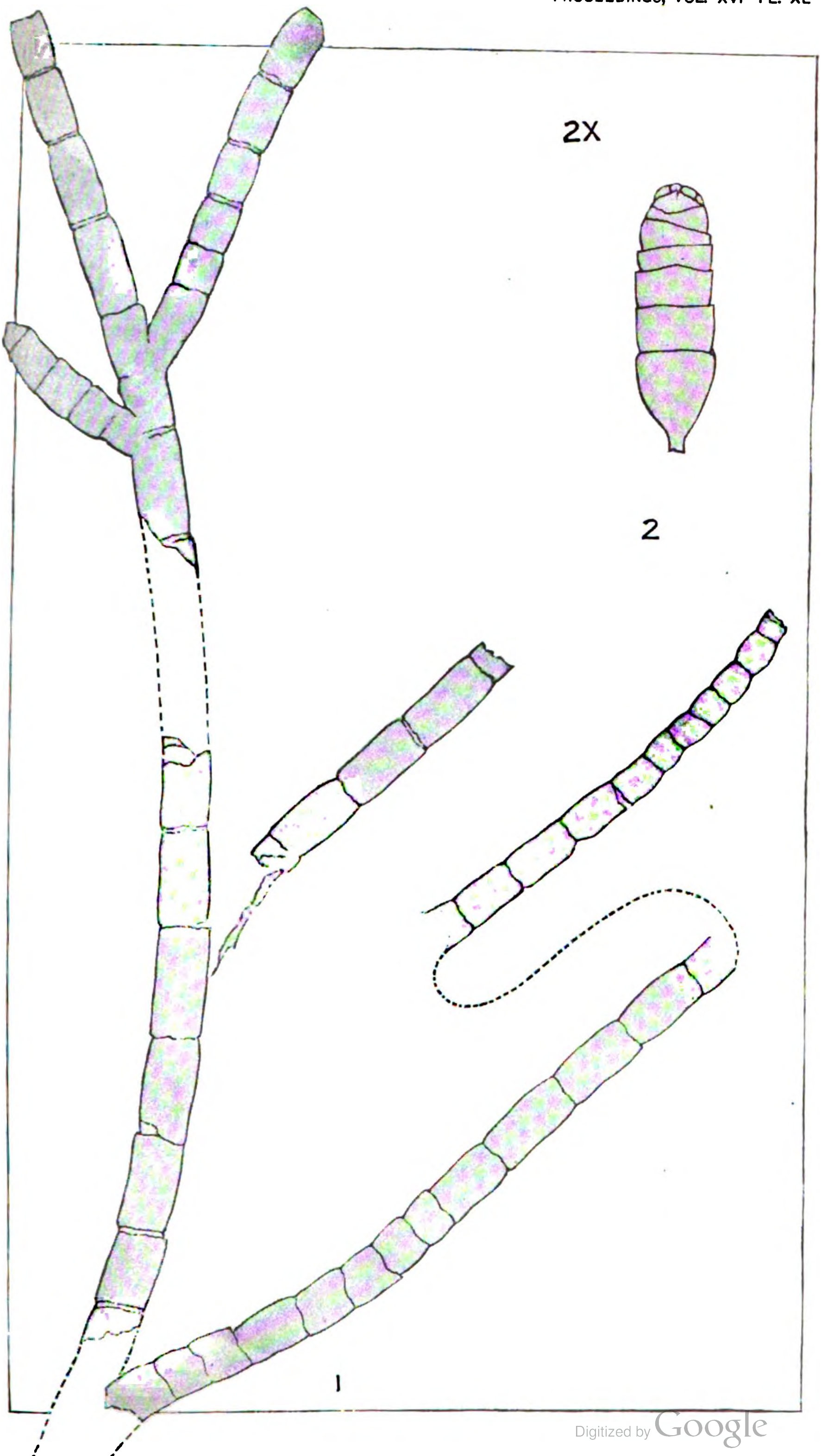
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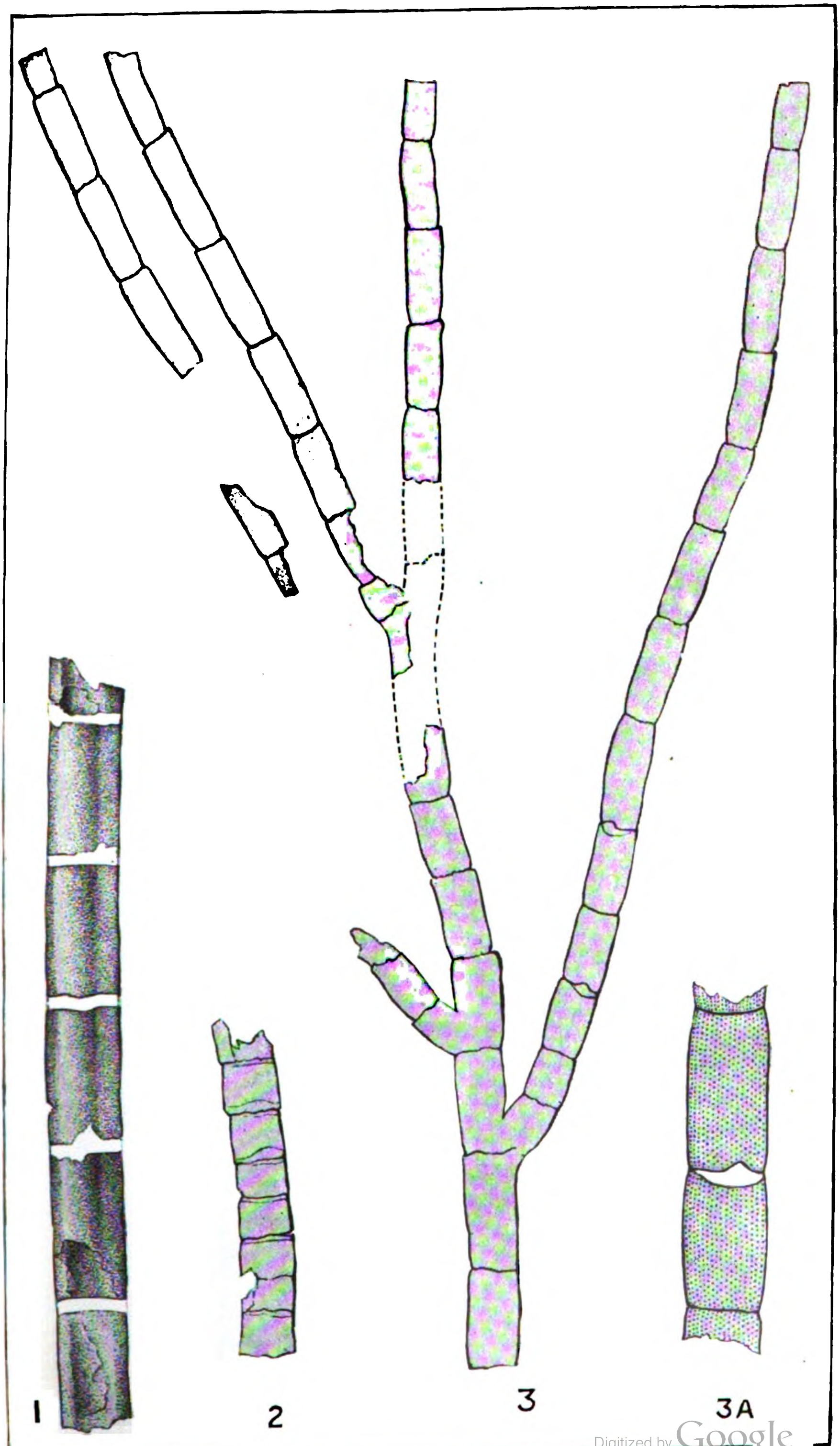
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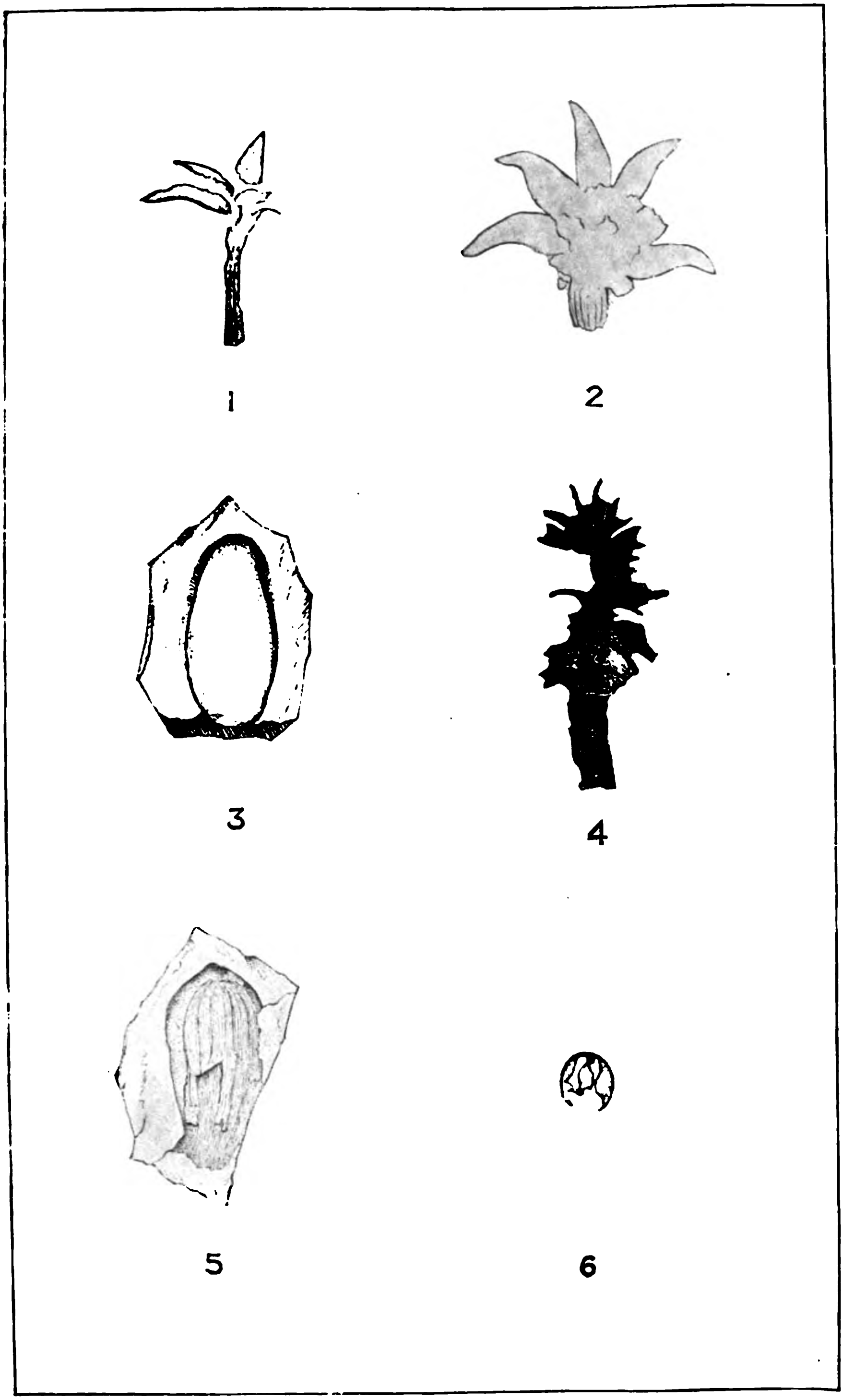

FOSSIL PLANTS FROM THE TRINITY OF TEXAS.

OBSERVATIONS ON THE BLIND CRAYFISHES OF INDIANA, WITH A DESCRIPTION OF A NEW SUBSPECIES; CAMBARUS PELLUCIDUS TESTII.

BY

W. P. HAY,

(With Plates XLIV–XLV.)

During the summers of 1891 and 1892, while visiting the caves of southern Indiana, an opportunity was afforded me to observe the habits and to collect specimens of the blind crayfish, *Cambarus pellucidus.*

The first cave visited is known as Mayfield's Cave and is situated about 3 miles west of Bloomington, Monroe County. Here nine specimens of a peculiar variety were caught and consigned to the alcohol bottle.

No more crayfishes were seen until I reached Bedford, in Lawrence County, although it is possible that they existed in the caves between the two places. The failure to find specimens was due to the heavy autumn rains which had so muddied the subterranean streams as to obscure everything in them.

Near Bedford, in Down's Cave, I collected two small specimens.

At Shiloh cave, 2 miles farther to the west, they were very common. This cave is a capacious one, and is traversed by a good-sized stream which will average a foot in depth. The bottom is of gravel and full of small stones which have fallen from the ceiling. A few crayfish were found here, but it was in a small branch running into the large stream about one-eighth of a mile from the entrance of the cave that they were the most abundant. The bottom of this branch is composed almost entirely of an exceedingly fine clay, with here and there a large rock which affords a ready hiding place for the animals.

When first observed, the crayfish were generally, I might almost say always, resting quietly in some shallow part of the stream on one of the banks of clay. They lay with all their legs extended and their long antennae gently waving to and fro. Once or twice I saw them on the shore a foot, at least, from the water, and one of these appeared to have been digging in the soft mud. When in the water I found it almost impossible to catch them with the net, and after a few trials threw it aside as useless. A much surer method was to approach them slowly

with the hand and then suddenly seize them. When once touched they started off in great haste for some protecting rock, but often in their alarm would dart out upon the bank where they would lie unable to get back to the water. They did not appear to be at all sensitive to the light. I have often tried the experiment of slowly passing my candle back and forth a few inches above them, or of suddenly removing the light and then bringing it close again, but with no effect whatever.

Noise has no effect; a loud call or a shrill whistle they do not notice. Nor does disturbing the waters seem to affect them, and it is only when they are touched that they manifest fear.

The larger of these crayfishes could inflict a pretty severe nip with their pinchers, but they did not appear to be so strong in this regard as the outside species.

When first taken from the water they were of a translucent pinkish white color with the stomach showing through as a blue body, but immersion in alcohol soon changed the color to an opaque white and obscured all traces of the internal organs.

At my first visit to Shiloh Cave I obtained sixteen specimens and on the second visit thirty-five.

I was unable to find more specimens of the blind crayfish until I reached Paoli in Orange County. Near this town I visited a small cave and obtained two specimens. At Orangeville, a little north of Paoli, they are said to be quite common in Lost River. At Marengo Cave the guide informed me that a few specimens had been obtained. At Wyandotte Cave they are said to be, at some seasons of the year, quite common, but at the time of my visit I secured only one small specimen. However, in a small unnamed cave, about one-fourth of a mile distant from the main cave, I obtained three fine specimens and observed another, which managed to escape. I was informed that they were abundant in other caves in the vicinity.

After reaching home, a careful examination of the collection brought out the following facts—

Of thirty specimens from Shiloh Cave, fourteen were males and sixteen females. It needed very little examination to determine that they belonged to the species *Cambarus pellucidus*, but rather to the variety which Prof. Cope has described as the variety *inermis* than to the typical form. The variation in the length of the rostrum and in the general spininess is very great. A complete series can be formed beginning with individuals provided very liberally with lateral spines and whose rostrum bears two sets of teeth near the acumen, and then running down to specimens which have the rostral teeth represented by only a salient angle and with very weak lateral spines. All the specimens, however, had *some* spines, on the sides of the carapace, postorbital ridges, or rostrum. It was in only one specimen, a female, that the rostral spines were missing.

Of the fourteen males, only one possessed hooks on both the third and fourth pairs of legs; the rest had them on the third pair only. In two cases, however, the hook on the fourth pair of legs is represented by a low, almost indistinguishable tubercle. This is also the case with one of the specimens from Wyandotte, and very close to the typical form. The Shiloh specimens with two pairs of hooks have the anterior ones rather strong and somewhat curved toward the base of the legs. The posterior pair are about half the length of the anterior. The hooks of the other specimens are of the same form, but are generally not so strongly developed. The specimens with a single pair of hooks probably belong to the second form of Hagen.

It may also be stated that, as a rule, *Cambarus pellucidus* is smoother the further north it occurs. The material which I have collected myself, and all that I have been able to obtain from others, will uphold me in this statement.

The small cave near Wyandotte produces individuals of exceeding spininess, it being the exception to find there a comparatively smooth one.

Coming further north, to Paoli, we can find much smoother specimens, and at Shiloh they are smoother still, while at Mayfield's Cave, in Monroe County, occurs a form entirely without spines. So constant is this feature of smoothness in the Mayfield Cave specimens and so different is its appearance from the typical *pellucidus*, that I think it is worthy of being characterized as a subspecies.

Cambarus pellucidus testii, subsp. nov. Pl. XLIV.

Cambarus pellucidus Packard. Monograph Cave Animals of N. A., Mem. Nat. Acad. Sci. Vol. IX, No. 9., p. 16.

Cambarus pellucidus Faxon. Notes on N. A. Crayfishes, Proc. U. S. Nat. Museum, Vol. XII, p. 621.

My attention was first drawn to the peculiar form of blind crayfish from Mayfield's Cave, by my friend, Mr. Frederick C. Test, of the U. S. National Museum, who sent me three specimens collected by him in 1888.

On account of the presence in these specimens of hooks on only the third pair of legs of the male, and other peculiarities, I was much inclined to think that they belonged to an entirely new and undescribed species, and it was for the express purpose of collecting additional specimens that Mayfield's Cave was visited by me.

The crayfishes are not very abundant, only nine being taken. They ranged in length from 24 to 68 millimeters. Six were males and three females.

They differ from *C. pellucidus* in the great reduction of the spines. Instead of being rough and very spiny, as the typical specimens from Mammoth Cave are described as being, they are entirely smooth. The lateral rostral spines are wholly gone, the post-orbital ridges are

smooth and rounded at the end, and the lateral spines of the carapace are at best represented by a few low, smooth tubercles.

The rostrum is shortened still more than in Prof. Cope's *inermis*, and instead of being "deeply sinuated to form the acumen," runs to a point in a gradual curve, very much resembling in this respect *C. acuminatus*.

The portion of the carapace in front of the cervical groove is shorter than in the average of specimens from Shiloh Cave, and conspicuously shorter than in specimens from Mammoth Cave. In respect to the hooks on the legs of the males I find the species variable. In none do I find hooks on both legs of the fourth pair; generally they are wholly wanting, but in some there is a small tubercle on one leg, which is missing from the other. The hooks on the third pair of legs are of a slightly different form from those of specimens from Shiloh or Wyandotte. They are shorter, blunter, and not curved.

The first abdominal appendages of the males do not differ in any respect from those of the typical *C. pellucidus*.

In the female the annulus ventralis shows marked differences from the typical forms.

The antennal scales, also, are different in form, and especially in length.

Were it not for a few specimens collected at Shiloh and one from Wyandotte, which in a few characteristics seem to approach the new variety and show an incomplete gradation into the typical form, I would feel justified in considering these Mayfield specimens as a distinct species.

More recently, Truett's Cave, a short distance from Mayfield's, has afforded one specimen of the new variety.

It would thus appear that *C. pellucidus testii* occurs only in those caves which form the most northern and outlying part of the cave region of southern Indiana.

Following is a list of the localities in Indiana from which blind crayfish have been taken. It will be seen that they are scattered over a large part of the southern half of the State, and subsequent exploration will probably show that they exist in every cave provided with running water.

Truett's Cave, Monroe County; Mayfield's Cave, Monroe County; Shiloh Cave, Lawrence County; Down's Cave,* Lawrence County; Dunnihue's Cave, Lawrence County; Connelly's Cave,* Lawrence County; Donnelson's Cave, Lawrence County; cave at Clifty, Bartholomew County (F. C. Test, J. F. Newsom); cave near Paoli,* Orange County; Marengo Cave, Orange County; Wyandotte Cave, Crawford County; small cave near and southwest of Wyandotte Cave; Wild Cat Cave, near Wyandotte; "caves in Harrison County;" "caves near Madison."

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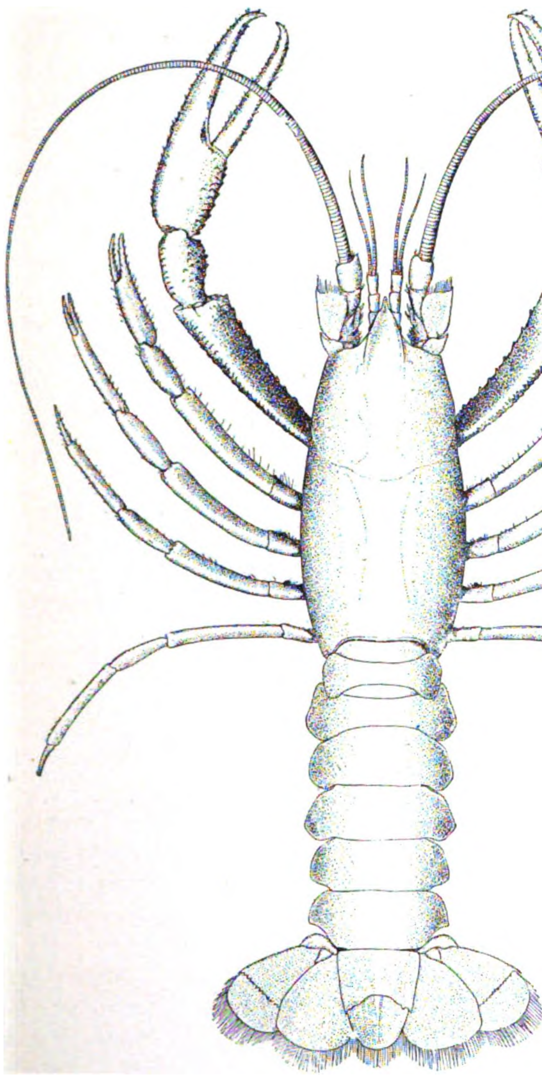
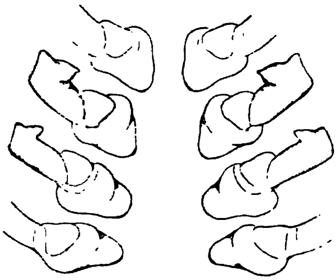
*It may be interesting, that among the many caves in which I observed *C. pellucidus*, these marked with an asterisk contained both it and *C. Bartonii*.



Cambarus pellucidus testii, sp. nov.; large male. One and a half times natural size. The right chela, wanting in the specimen, is reproduced from left side.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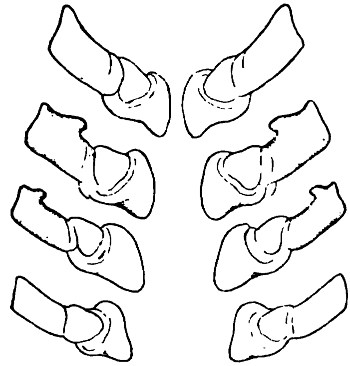
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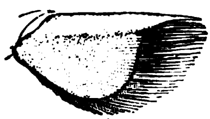
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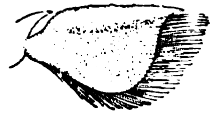
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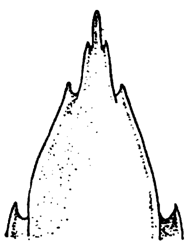
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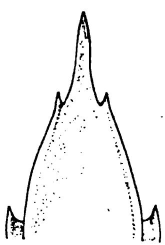
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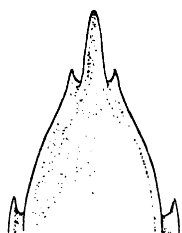
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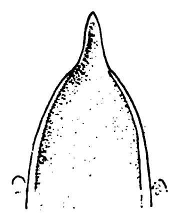
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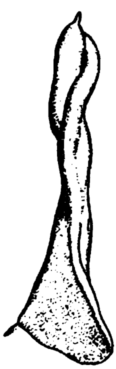
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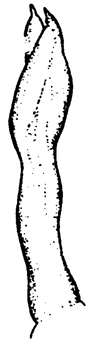
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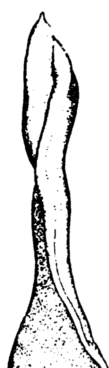
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1. Ventral surface of the thorax of *C. pellucidus*, showing the first joints of the legs with their hooks.
2. Same of *C. pellucidus testii.*
3. Annulus ventralis of *C. pellucidus.*
4. Antennal scale of *C. pellucidus.*
5. Annulus ventralis of *C. pellucidus testii.*
6. Antennal scale of *C. pellucidus testii.*

7, 8, and 9. Rostra of *C. pellucidus*, a series showing different arrangement of spines.
10. Rostrum of *C. pellucidus testii.*
11 and 12. First abdominal appendages of *C. pellucidus testii.*
13 and 14. First abdominal appendages of *C. pellucidus.*

THE SHOFAR—ITS USE AND ORIGIN.*

BY

CYRUS ADLER,

Assistant Curator of Oriental Antiquities.

(With Plates XLVI–XLIX.)

The modern Jewish synagogue has preserved in its ceremonial, among other customs, the use of the shofar, translated in the English version of the Bible "cornet." Several times during the service on New Year's day, or *Rosh hashanah*, at the conclusion of the Day of Atonement, on the seventh day of the festival of Tabernacles or *Sukkoth*, *Hosh'ana Raba*, and during the entire month of Ellul, after the recital of the supplications or *Selichoth*, the shofar is sounded. Its use on all these occasions is not general and probably never was, but it still survives in many places. For the New Year's service it is the characteristic feature.

The shofar is usually made of a ram's horn, straightened and flattened by heat. All natural horns can be shaped either by heat or by cooking in oil.†

The bore of the instrument is a cylindrical tube of very small caliber, which opens into a kind of bell of parabolic form.‡

It is not only the solitary ancient musical instrument actually preserved in the Mosaic ritual, but is the oldest form of wind instrument known to be retained in use in the world.§

In the discussion of Wetzstein's paper, cited below, Prof. Steinthal pointed out that this was an instrument no doubt used in prehistoric times.

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* In the abstract of this paper published in the proceedings of the American Oriental Society, October, 1889, p. CLXXI, ff., I made the request for the communication of additional information on the subject, and I have been favored with some valuable suggestions from the late Prof. Paul de Lagarde, of Göttingen.

† I have recently met a curious survival of the use and manufacture of a musical instrument made of natural horn. While walking on Pennsylvania avenue, Washington, August 22, 1890, I saw a negro boy about 10 years of age with a cow horn in his hand. He told me that he had cut off the end, shaped the mouthpiece with a hot poker, and then scraped it with a knife. On being urged, he blew it quite easily. I endeavored to secure possession of it, but the boy declined to part with his handiwork.

‡ Musical Instruments Historic, Rare, and Unique, by A. J. Hipkins, Edinburgh, Black, 1888, p. 12.

§ *Ibid.*, p. 1, and South Kensington Museum Art Books, edited by William Maskell; Musical Instruments, by Carl Engel, London, 1875: Chapman & Hall, p. 24.

There seems to be little doubt that it has been continuously used in the Mosaic service from the time it was established until now. (Hipkins, XII)

FORM.

The shape of the instrument varies considerably. The modern examples are usually flat (Pl. XLVI, No. 1). Two Italian specimens of the seventeenth century preserve the form of the natural horn; the first of these is in possession of the Rev. Dr. S. Morais, of Philadelphia; it was procured for him from Venice by Dr. Isaiah Luzzatto, of Padua. The second Italian specimen (Pl. XLVI, No. 2) was collected by Dr. H. Friedenwald, and belongs to the National Museum collections. The same shape is exhibited in a beautiful example figured by Hipkins (Pl. XLVII, No. 1), preserved in the Great Synagogue, Aldgate, London. A number of excellent specimens were brought together at the Anglo-Jewish Historical Exhibition, held in London in 1887. They are figured in the accompanying plates and briefly described in the list of illustrations. Occasionally the instruments contain Hebrew inscriptions. Such an one, found near Dessau, was exhibited before the Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, at the meeting of March 20, 1880, and formed the subject of a valuable paper by T. G. Wetzstein (pp. 63–73. See Pl. XLVII, No. 3). A similarly carved and inscribed instrument is in the possession of a lady in New York (Pl. XLIX, No. 1). The inscription reads: "Happy are the people who know the sound (of the shofar)," and on the reverse, "In the light of Thy countenance shall they walk." The inscription on the Dessau instrument consists of Isaiah xxvii, 13 (quoted below), and the two blessings recited by the person who blows the instrument: "Blessed art Thou, O Lord, our God, King of the Universe, who has sanctified us with His commandments and commanded us to hear the sound of the shofar;" "Blessed art Thou, O Lord, our God, King of the Universe, who has caused us to live, and preserved us, and caused us to reach this time." (Wetzstein, p. 65.)

The shofar was not the only natural horn used by the Israelites as a musical instrument, but no copies or representations of the other instruments have come down to us.

Some commentators are of the opinion that the instrument known in the Bible by the generic name of *qeren*, was also made of ram's horn, and was very nearly identical with the *shofar*, the only difference being that the latter was more curved than the former. (Engel., p. 24.)

METHOD OF SOUNDING.

The method of sounding the shofar has been handed down by tradition, though it varies slightly in different communities. Three sounds are employed: the shortest, or *teqi'a*, a broken or interrupted sound,

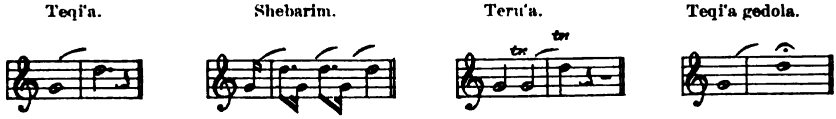
shebarim, consisting in the *teqiʿa*, given three times, and *teruʿa*, which is simply a prolongation of the *teqiʿa*. *Teruʿa gedola*, or the great teruʿa, is merely an exaggeration of the simple sound of that name. The German Jews sound the *teqiʿa gedola* or great *teqiʿa*. (Hipkins, p. xiii.)

The sound is produced by the ejection of a volume of air into the trumpet through the lips, which act as a reed, pressed against the orifice of the trumpet.

According to Hipkins the embouchure of the shofar is very difficult, and but three proper tones are usually obtained from it, although in some instances higher notes can be got. The short rythmic flourishes are common, with unimportant differences, to both the German and Portuguese Jews, and consequently date from before their separation. These flourishes, as used in the ritual, are *teqiʿa* CG *shebarim* C | GC | GC | G and *teruʿa* CCCC | CCCC | CCCC | G usually a tongued *vibrato* of the lower note. The *gedolh* is the great *teqiʿa* concluding the flourishes (p. xiii). "The notes here given are those usually produced, but from the empirical formation of the embouchure, and a peculiarity of the player's lips, an octave is occasionally produced instead of the normal fifth." My own observation has led me to the conclusion that the production of the octave is quite common. The fundamental, if obtained, is not regarded as a true shofar note.

Wetzstein gives the following musical notation.

Teqi'a. Shebarim. Teru'a. Teqi'a gedola.



According to *Mishna Rosh hashana* (IV, 9) the order of sounding the shofar is as follows: three sounds are blown thrice, the time of the duration of six *teqiʿas* is equal to that of three *teruʿas*, and that of each *teqiʿa* is equal to three sighs or moans.

From this it would appear that the interrupted sound or *shebarim* was not known when this Mishna was written. This conclusion, however, can not be drawn with certainty.

THE SHOFAR IN THE LITURGY.

Portions of the liturgy for New Year's Day have especial reference to the sounding of the shofar. First among these is the hymn, *Adonai beqol shofar*, by an unknown author: "With the sound of the trumpet will the Lord publish salvation, to assemble the scattered sheep at the coming (accomplishment) of the vision of salvation. God is exalted with a triumphal shout."

"With the sound of the trumpet God causes a voice to be heard from heaven, on the holy mountain, and on Jerusalem; then shall the place be established, by Thy right hand shall be restored to its primitive state. God is exalted with a triumphal shout."

"With the sound of the trumpet the Lord will reveal the period and appointed time, when He will blow the trumpet and go in the whirlwinds of the south; then shall the wicked kingdom of Edom be destroyed. God is exalted with a triumphal shout."

"O Lord, with the sound of the trumpet wilt Thou blow upon the holy mountain; the beautiful dwelling of Zion wilt Thou expand; Mount Seir shall be rent; the fixed stake shall be plucked up and removed. God is exalted with a triumphal shout."

This is followed by a hymn composed of the various passages (to be discussed later on) in the Bible, in which the use of the shofar is mentioned. The sounding of the cornet thereupon follows.

The liturgy of the German and Polish Jews contains the ten reasons for sounding the shofar stated by Saadia Gaon.*

Rabbi Saadia observes that God commanded us to sound the cornet as alluding to the following subjects:

First. Because this day is the beginning of the creation on which God created the world and thus began to reign over it; and as it is customary at the coronation of kings to sound the trumpets and cornets to proclaim the commencement of their reign, we, in like manner, publicly proclaim, by the sound of the cornet, that the Creator is our king, and thus says David, "With trumpets and the sound of the cornet shout ye before the Lord."

Second. As the New Year is the first of the ten penitential days, we sound the cornet as a proclamation to admonish all to return and repent, which if they do not, they can not plead ignorance, as having been fully informed. Thus also we find earthly kings publish their decrees that none may plead ignorance thereof.

Third. To remind us of the law given on Mount Sinai, as it is said, Exodus XIX, 16, "and the voice of the cornet was exceedingly loud," and that we ought to bind ourselves to the performance thereof, as our ancestors did, when they said, "All that the Lord has said, will we do, and be obedient."

Fourth. To remind us of the prophets who are compared to watchmen blowing the trumpets as mentioned in Ezekiel XXXIII, 4, "Whosoever heareth the sound of the cornet and taketh not warning, and the sword cometh and taketh him away, his blood shall be upon his own head, but he that taketh warning shall save his life."

Fifth. To remind us of the destruction of the Holy Temple, and the terrifying alarm of the enemy's warriors shouting to battle as mentioned in Jeremiah IV, 19, "because thou hast heard, oh my soul, the sound of the trumpet, the alarm of war," and therefore, when we hear the sound of the cornet, we ought to beseech the Almighty to rebuild the Holy Temple.

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* Saadia ben Joseph, 892-942, one of the great Jewish scholars of the middle ages. He translated the Bible into Arabic and wrote many important works.

Sixth. To remind us of the binding of Isaac who willingly submitted himself to the will of Heaven; thus ought we also willingly submit even to death itself, for the sanctification of the unity of His holy name.

Seventh. That when we hear the sounding of the cornet we may, by the dread thereof, be induced to humble ourselves before the Supreme Being, for it is the nature of these martial wind instruments to produce dread and terror. As the prophet Amos observes, "shall a trumpet be blown in a city and the people not be terrified?"

Eighth. To remind us of the great and awful day of judgment on which the trumpet is to be sounded as mentioned, Zephaniah I, 14–16: "The great day of the Lord is near, it is near and hasteneth much, a day of the trumpet and of shouting."

Ninth. To remind us to pray for the time when the outcasts of Israel are to be gathered together, as mentioned, Isaiah XXVII, 13, "and it shall come to pass in that day, the great trumpet shall be sounded and those shall come who were perishing in the land of Assyria."

Tenth. To remind us of the resurrection of the dead and the firm belief thereof, as the prophet Isaiah saith "Yea, all ye that inhabit the world, and that dwell on the earth, when the standard is lifted up on the mountain, ye shall behold when the trumpet is sounded, ye shall hear."

The Biblical passages relating to the trumpet are again employed in the additional service or *Musaf*, which is read on Sabbaths and holidays in place of the additional sacrifice commanded for those days.

In *Mishna Rosh hashana* (IV, 5) minute directions are given as to the nature of the Biblical passages to be employed.

The order of the blessings is as follows: *Aboth* (relating to the forefathers), *qedushath hashem* (relating to the holiness of God), and *geburoth* (relating to the greatness of God), and joined with them are the *malkiyoth* (relating to God as king), and the shofar is not sounded; then come texts concerning the holiness of the day, after which the shofar is sounded; then follow the *zikronoth* (memorials), after which the shofar is again sounded. Next follow the *shofaroth* (relating to the shofar), and the shofar is sounded; he then says *abodah* (worship), *hoda'ah* (thanksgiving) and *birkath kohanim* (the priestly blessing). Such is the opinion of Rabbi Jochanan ben Nourrie; but Rabbi Aqiba objected saying to him: "If the shofar is not to be sounded after the reading of the *malkiyoth* why are they to be mentioned?" But the proper order is the following: *Aboth*, *geburoth*, and *qedushath hashem* are said with which the *malkiyoth* are to be combined; after which the shofar is to be sounded, then the *zikronoth* are to be read, and the shofar sounded; next *shofaroth* and the shofar is again sounded; after which *abodah*, *hoda'ah* and *birkath kohanim* are said. *Mishna Rosh hashana* (IV, 6) provides that no less than ten texts relative to *malkiyoth*, *zikronoth*, and *shofaroth* must be said.

Part of the Bible lesson of the day consists of a recitation of the sacrifice of Isaac, and there is a hymn in the service which dwells on

the incident. It is possible that it was sought to establish a basis for the sacredness of the Ram's horn from the fact that it was a ram or *'ayil* which was caught in the thickets by its horns and which served as an offering instead of Isaac. In *Talmud Rosh hashana* we read "Ye shall blow before me with a shofar of a ram, in order that ye may be reminded of the sacrifice of Isaac, the son of Abraham."

The hymn referred to above contains the acrostic Abbas, Judah, Samuel: *i. e.*, Judah ben Samuel ibn Abbas, a poet of the twelfth century, who traveled from Spain to the Orient, and afterward became Rabbi of Fez.*

MISHNIC REGULATIONS.

The Mishna permitted the use of any horn. In *Rosh hashana* III, 3, we read: "Every kind of horn may be used because it is a qeren." Rabbi Jose remarked, are not all shofars called qeren (horn)? (Joshua VI, 6.)

The shofar of New Year's day was usually the straight horn of a ya'al, a kind of antelope or wild goat (chamois), the mouthpiece of which was covered with gold; while the shofar of fast days was a ram's horn whose mouthpiece was covered with silver.

The statute is found in *Mishnah Rosh hashana* III, 3: "The shofar of the New Year was the straight horn of a ya'al, the mouthpiece of which was covered with gold, and two trumpets were placed on either side. The sound of the shofar was prolonged and that of the trumpets made short, because the command of the day is for the shofar; (IV) and on fast days crooked ram's horns were used, whose mouthpieces were covered with silver and two trumpets were stationed between them. The sound of the shofar was made short and that of the trumpets prolonged, because the command of the day is with reference to the trumpets (V). The year of the jubilee is like the New Year with respect to the sounding and the blessings. Rabbi Jehudah, on the contrary, says: "On New Year they sound with the horns of rams, and at the Jubilee with chamois."

The instrument used in the modern synagoge has no adornments. It probably represents a more ancient form than the instrument described in the Mishna.

A shofar, which had been broken and joined together could not be employed, though its use was admissible, if it contained a hole which had been closed so as not to interfere with the sound.†

In the modern synagogue the shofar is not sounded on New Year's day when it occurs on the Sabbath. This seems to have been the

* Karpeles, *Geschichte der Judischen Literatur*, p. 496.

† "It is unlawful to use a shofar which had been rent and afterwards joined together; also one composed of several pieces joined together. If a shofar had a hole which had been closed, if it hinders the proper sound, it may not be used; but if it does not affect the proper sound it may be used."—*Mishna Rosh hashana*, III, 6.

ancient rule after the destruction of the temple, though it was subject to some modification.*

Mishna Rosh hashana, IV, provides that some person other than the reader shall sound the shofar.†

BIBLICAL PASSAGES.

We will now proceed to examine the biblical passages with reference to the shofar. Its use for religious exercise is prefaced by the presence of its sound at the giving of the law. (Exodus, XIX, 19; XX, 18.)

It is mentioned with other instruments as a fitting announcement of the new moon. The solemn feasts were similarly announced. New Year's day was a "memorial of blowing," though it will be noticed that the passages in the Pentateuch which refer to this day, both use the word "*teru'ah*," or blowing, without expressly mentioning the shofar itself.

"Speak to the children of Israel as follows: In the seventh month, on the first day of the month, there shall be to you a Sabbath, a memorial of blowing, a holy convocation" (Lev., XXIII, 24), while in another passage it is simply called "a day of blowing" (Numbers, XXIX, 1).

Special feasts or solemn assemblies for particular purposes were announced by the blowing of the shofar. (Joel, II, 15.)

The great year of release, which occurred after the enumeration of seven times seven years, was announced by the sounding of the shofar, not at the beginning of the year, on New Year's day, as might be expected, but ten days thereafter, on the Day of Atonement. (Leviticus, XXV, 9.)

In Isaiah's vision of the great day of judgment the shofar is blown

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*"When the feast of the New Year happened on the Sabbath they used to sound the shofar in the sanctuary, but not out of it. After the destruction of the temple, Rabban Jochanan, son of Zaccai, ordained that they should sound (on the Sabbath) in every place where there is a tribunal of justice (*Beth Din*). Rabbi Eleazar says: "He only issued this order in respect to Jamnia," but they (the other sages) said unto him, "it was the same for Jamnia as for any other place in which there is a permanent tribunal of justice."

"And in this respect also was Jerusalem privileged above Jamnia, viz, that every city from whence Jerusalem could be seen and the sounding heard, which was near enough, and to which it was allowed to go on the Sabbath, might sound; but in Jamnia it was only permitted to sound before the tribunal of justice.—*Mishna Rosh hashana*, IV, 2.

†"It was not permitted for the purpose of sounding the shofar on the feast of New Year, to go beyond the Sabbatical limits, to remove a heap of stones under which a shofar is buried, mount a tree, ride on any animal, or swim over the waters to get a shofar, nor may he cut it with anything that may not be used, on account of transgression against the Sabbatical rest, nor disobey on its account any negative precept of the law; but a person may, if he choose, pour water or wine into the shofar to improve its sound. Children should not be prevented from sounding, but on the contrary it is lawful to be occupied in teaching them to sound."—*Mishna Rosh hashana*, IV, 8.

to assemble "those who are lost in the land of Asshur and those who are outcasts in the land of Egypt." (XXVII, 13.)

When David removed the ark to Jerusalem the sound of the shofar was heard in the procession. (II Samuel, VI, 15; I Chron., XV, 28.)

It is mentioned along with other musical instruments as a proper accompaniment of psalmody. "Praise Him with the blowing of the shofar, praise Him with the psaltry and the harp." (Ps., CL, 3; cf. also XCVIII, 6.)

Some years ago I was informed it had been introduced into opera by an Italian composer, with what success I do not know.

WAR HORN.

The most ancient use of signals of any sort was no doubt to apprise a tribe of the coming of an enemy and to call together the clansmen for defense. Possibly the earliest, certainly the most frequent use of the shofar in Israel, was for military purposes.

The ancient Egyptians used a trumpet for military purposes, but it was a long, straight metallic instrument like the Hebrew *haçoçera.* (Wilkinson, I, 104f.)

The troops seemed to have marched to its notes. (*Ibid.*, woodcut 289, and Rawlinson, History of Ancient Egypt, Vol. I, p. 491.)

The shofar could be heard at a great distance. There is an allusion to its loudness in Isaiah (LVIII, 1): "Cry with a full throat, spare not, like the shofar lift up thy voice, and declare unto my people their transgression, and to the house of Jacob their sins."

It played an important part in the imposing demonstration made before the walls of Jericho. (Joshua, VI, 4, 5, 6, 8, 9, 13, 16, 20.)

When Gideon was filled with the spirit of the Lord he assembled the outlaws who composed his army by blowing the shofar (Judges VI, 34). Each man carried one of the instruments and the noise thereof very materially contributed to the surprise of the Midianite army. (Judges, VII, 8, 16, 18, 19, 20, 22.)

In the actual narrative itself, the shofar is not as frequently mentioned as the constancy of its use for certain purposes might lead us to expect. The infrequency of its mention is in a way, however, a sort of evidence of the frequency of its use. The blowing of the bugle is as regular a part of a charge as the horses on which the cavalry is mounted. Its picturesqueness would naturally strike the mind of a poet and so the references to the shofar in the prophetical books are numerous.

In the following nineteen passages from the prophets, the shofar symbolizes war:

"Tell ye in Judah, and publish in Jerusalem, and say, Blow ye the shofar in the land: call out, gather together, and say, Assemble yourselves, and let us go into the fortified cities." (Jeremiah, IV, 5.)

"My bowels, my bowels! I am shaken, at the very chambers of my

heart; my heart beateth tumultuously in me; I can not remain silent; because the sound of the shofar hast thou heard, O my soul, the alarm of war." (Jeremiah, IV, 19.)

"How long shall I see the standard, hear the sound of the shofar?" (Jeremiah, IV, 21.)

"Assemble, O ye children of Benjamin, to flee out of the midst of Jerusalem, and in Thekoa, blow the shofar and on Bethhakkerem set set up a fire signal; for evil is seen (coming) out of the north, and great havoc." (Jeremiah, VI, 1.)

"Then did I set watchmen over you, (saying) Listen to the sound of the shofar. But they said, We will not listen." (Jeremiah, VI, 17.)

"Saying, No; but into the land of Egypt will we go, that we may not see war, nor hear the sound of the shofar, and that we may not have hunger for bread; and there will we dwell." (Jeremiah, XLII, 14.)

"Lift ye up a standard in the land, blow ye the shofar among the nations." (Jeremiah, LI, 27.)

"And if he see the sword coming over the land, and blow the shofar and warn the people." (Ezekiel, XXXIII, 3.)

"And whosoever heareth the sound of the shofar and taketh no warning; and the sword cometh, and taketh him away, his blood shall be upon his own head." (Ezekiel, XXXIII, 4.)

"The sound of the shofar hath he heard, and he hath taken no warning; his blood shall be upon him. But had he taken warning he would have delivered his soul." (Ezekiel, XXXIII, 5.)

"But if the watchman see the sword coming, and blow not the shofar so that the people be not warned, and the sword cometh, and taketh away from among them some person, this one is taken away for his iniquity; but his blood will I require from the watchman's hand. (Ezekiel, XXXIII, 6.)

"Blow ye the shofar in Gib'ah, the trumpet in Ramah; blow the alarm at Beth-aven. (The enemy is) after thee, O Benjamin." (Hosea, V, 8.)

"Set the shofar to thy mouth. (Let the enemy come) like the eagle against the house of the Lord; because they have transgressed my covenant, and against my law have they trespassed." (Hosea, VIII, 1.)

"Blow ye the shofar in Zion, and sound an alarm on my Holy Mount; let all the inhabitants of the land tremble; for the day of the Lord cometh, for it is nigh." (Joel, II, 1.)

"And I will send a fire against Moab, which shall devour the palaces of Keriyoth; and Moab shall die in the tumult, in the shouting, amidst the sound of the shofar." (Amos, II, 2.)

"Shall a shofar be blown in a city and the people not become afraid? Shall there be evil in a city, and the Lord have not done it." (Amos, III, 6.)

"A day of the shofar and alarm, against the fenced cities, and against the high battlements." (Zephaniah, I, 16.)

"With impatient noise and rage he holloweth (with his hoof) the

ground, and keepeth not quiet when the shofar's voice (is heard)." (Job, XXXIX, 24.)

OTHER USES.

From the Talmud we learn that the use of the shofar as a note of alarm of war was transferred to other seasons of danger and distress. Famine, plague of locusts, and drought (Mishna Taanith, I, 6) occasioned the blowing of the shofar.

The shofar was employed at the public ceremony of excommunication.* (Wetzstein, p. 67.)

A very curious use of the shofar in later times was in funeral ceremonies (Wetzstein, p. 67). I agree with Wetzstein that this use of the instrument is quite apart from the usual Semitic custom and was probably borrowed.

As a signal instrument of war it had various uses, possibly according to the note that was blown. It was the signal for going out to battle, for the announcement of a victory, and for a recall of the troops.

It was with the shofar that Ehud assembled the people. "And it came to pass, when he was come, that he blew the shofar on the mountain of Ephraim, and the children of Israel went down with him from the mountain and he before them." (Judges, III, 27.)

"And again there happened to be a worthless man, whose name was Sheba, the son of Bichri, a Benjamite, and he blew the shofar and said, 'We have no part in David, nor have we any inheritance in the son of Jesse; every man to his tents, O Israel.'" (II Samuel, XX, 1.)

Isaiah refers to this use (XVIII, 3):† "All ye inhabitants of the world, and dwellers on the earth, when the ensign is lifted upon the mountains, see ye; and when the shofar is blown, hear ye."

When Jonathan had defeated the Philistines in Geba, "Saul blew the shofar throughout all the land, saying, Let the Hebrews hear," (I Samuel XIII, 3,), and thus become acquainted with the victory.

It announced the end of the struggle between Abner and Joab which succeeded the death of Saul. (II Samuel, II, 28.)

After the death of Absalom, which really ended the revolt against David, Joab blew the shofar and the people returned from pursuing after Israel. (II Samuel, XVIII, 16, *cf.* also II Samuel, XX, 22.)

The shofar was employed to announce the coronation of a king. This may be considered but a feature of its use for military purposes, since, as some of the passages about to be quoted show, the coronation

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*In *Sanhedrin*, 7 b., we read: "Rab Huna when about to hold court was accustomed to ask for the implements of his trade: a rod, a strap, a shofar, and a sandal." The shofar, remarks Rashi, was for use at an excommunication.

†Nakáreh Khâneh, a rock near Bandamir, in Persia, is so called (according to tradition) because at the sound of drums and trumpets the workmen engaged on the walls and dikes in the neighborhood assembled there to receive their wages and provision. (Ousely, II, 186.)

of the king and the announcement of his victory over some other tribe or faction were one and the same event.

When Absalom was engaged in the revolt against his father he sent spies among all the tribes of Israel announcing his intentions and informing them that when they heard the shofar sounded they might say that he had become king. (II Samuel xv, 10.)

In the directions given with regard to the coronation of Solomon the use of the shofar is expressly mentioned (I Kings, I, 34 and 39), and its sound affrighted Adonijah and guests at their banquet. (I Kings, I, 41.)

The overthrow of the house of Ahab and the coronation of Jehu were proclaimed in the same way. (II Kings, IX, 13.)

ETYMOLOGY.

The etymology of shofar is not at all clear. Gesenius derived it from the stem *shafar* "to be bright, clear, beautiful—possibly on account of its clear sound," but this is hardly satisfactory. The editors of the eleventh edition of Gesenius retain the same explanation.*

Nothing can be learned from Arabic *šabbûr*.† This is simply borrowed from the Talmudic form *šippûra* or *šippûr*, the b in Arabic representing the Hebrew p, as the Arabic possesses no p, but only f.‡

The trumpet now used by the Arabs of Asia Minor, which they call *šeifur*, is a metallic instrument. It is possible, however, that the word was originally applied by the Arabs to an instrument of horn.§

The Arabian Jews called the shofar *šaafar*. We may, however, get some light from Assyrian. ||

According to Stade (Grammar, par. 218*a*) the Hebrew shofar stands for a form *sappar*, and exactly this form has been found in Assyrian. In a cuneiform list of animals (II Rawlinson, VI, 6 cd) we find, following *atûdu*, "he goat," the word *šapparu*, which is accordingly the name of an animal, possibly of the goat order. The word also occurs in a

*They say parenthetically that the shofar was the shape of a horn and *possibly* made of horn.

†Wetzstein, p. 73, proposes an Arabic etymology; *šufra* and *šafîr* in Arabic mean edge or corner, and it is probably his idea that they bear the same relation to shofar that corner bears to Latin *cornu*. The late Prof. de Lagarde compared shofar with Armenian *shifora* (*Armenische Studien*, p. 117, No. 16931).

‡*Cf.* Siegmund Fraenkel, *Die Aramaischen Fremdworter im Arabischen*, Leyden, 1888, p. 24.

§See Musical Instruments and their Homes, by Mary E. Brown and William Adams Brown (New York, 1888), p. 196. It is principally interesting because it resembles the trumpet played by an Assyrian warrior on a bas-relief of Nineveh and the Hebrew trumpet represented on the arch of Titus at Rome. This latter is not identical with the shofar; it is the straight metallic trumpet or *haçoçera* which is represented on the arch of Titus (Engel, p. 24).

||Fr. Delitzsch, *Prolegomena eines neuen Hebraisch-Aramaischen Worterbuches zum Alten Testament*, Leipzig, 1886, p. 125.

bilingual incantation (V Rawlinson, 50, 47–49*b*) describing the action of the disease called *asakku*. The passage reads: *turâha ina qaqqadišu u qarnišu iççabit, atûda šappar šadî šappartašunu iççabit*, "the mountain goat by its head and horns it seizes, the he goat, the šappar of the mountain, by its šappartu it seizes." Here *šappartu* undoubtedly means "horn," being the feminine form used in Semitic to denote lifeless objects (Gesenius, Grammar, par. 107, 3, *a*); the conclusion would, therefore, be that the shofar is so called because it was originally made of the horn of the species of goat called *šappar*.* The Hebrew shofar corresponds to Assyrian *šappartu*, it being worthy of notice that shofar, although not possessing the feminine termination in the singular, always makes a feminine plural.

In the discussion on the Wetzstein paper Mr. Hartmann suggested that the peculiar shape of the horn given to it artificially was intended to imitate the shape of the horn of some wild animal, possibly the wild sheep (*Ovis cyprias*); not that I apprehend that the suggestion is exactly correct, since, as will be seen, the shape is not uniform. The suggestion, however, that the horn was not that of a domesticated animal, but of an animal more difficult to get, seems to have a certain inherent probability.

Wetzstein is of the opinion that the use of the ram's horn may have been borrowed by the Israelites and goes back to a people who were engaged solely in the care of sheep. By these it was used as a signal of alarm.

SIMILAR INSTRUMENTS.

Various ancient and modern nations have used the horns of animals for wind instruments. The following specimens are preserved in the collection of musical instruments in the U. S. National Museum.

At the time of the Festival of the Prophet the Berbers use a horn which consists of two rams' horns joined at the ends and provided with metal mouth-pieces. This instrument is now called zamr. The specimen belongs to the National Museum and was collected by Mr. Talcott Williams.

The Shringa, "an ancient outdoor wind instrument of the horn species. It is commonly known as the Indian horn. It was the favorite instrument of the Hindu god Siva." It is a common ox or buffalo horn of dark color, scraped and polished, the tip cut off and the embouchure enlarged and shaped with a hot iron. It is 12½ inches in length and the diameter varies from five-eighths to 2½ inches. In form it differs in nowise from the shofar. (Pl. XLVI, No. 4.)

The *Embuchi*, also known as the *Ponza*, *Apunza*, and *Oukpwe*, an African trumpet or war horn made of an elephant's tusk, the natural cavity

* Baron von Korff, in the discussion of Wetzstein's paper, asserted that the goat horn was still used for making shofars by the Jews of Poland. If this statement be correct it would point to a tradition more ancient than that contained in the Jewish liturgy.

forming the bore of the horn. (Pl. XLVI, No. 10.) The embouchure is formed on the inner or concave side of the tusk, the ivory being worked away so as to leave a projecting mouthpiece 3⅝ inches long, 1½ inches wide and one-half inch high. The instrument itself is 21½ inches long; the diameter tapers from 3¼ by 3¾ to three-fourths of an inch. It is made by the Palla Balla negroes of the Lower Congo.

African war horn made of elephant's tusk, rudely carved about the mouth hole and smaller end. It is suspended by a cord of human hair sennit. The natural cavity forms the bore of the horn. The embouchure is made in the concave side of the horn and is elliptic in shape. The instrument is 20 inches long, the diameter of the bell being 3½ inches. There are four other war horns of elephant's tusks, made in various parts of Africa, which do not differ in form from the specimens described above.

The natives of Sumatra use a trumpet made of the horn of a cow.*

The earliest metal trumpets were constructed on the same principle as the shofar, and in some cases the form of the instrument is plainly a copy of some natural horn.†

In one of the smaller mounds at Tello, M. de Sarzec discovered a fragment of a large bronze statue. "It was," he says, "a life-sized bull's horn of bronze plating, mounted on a wooden frame, but the wood was carbonized by the action of fire."

There is a Siamese engraved copper horn in the U. S. National Museum shaped like a buffalo horn. (Pl. XLVI, 5.) The British Museum possesses a bronze Etruscan cornu (engraved), constructed on the same principle (Engel, p. 33). Of similar pattern was the tuba. Both the cornu and the tuba were employed in war to convey signals (*ibid.*, p. 36).

The Greeks had a curved horn, *keras*, made of brass, and a straight horn, *salpinx*, exclusively used in war (*ibid.*, p. 32). Trumpets are often mentioned by writers who have recorded the manners and customs of the Indians at the time of the discovery of America (*ibid.*, p. 67). No specimen of such trumpets have so far been discovered among North-American aboriginal remains. A wooden wind instrument is in use among the Carvadoo, an Indian tribe in Brazil. "With this people it is the custom for the chief to give on his war trumpet the signal for battle, and to continue blowing as long as he wishes the battle to last" (*ibid.*, p. 69).

The metallic descendant of the Indian buffalo horn, the *shringa*, mentioned above, is the *rana shringa*, an outdoor instrument made of copper, formerly used in military and now universally in religious processions throughout India, both by Hindus and Mohammedans, the

* *Indonesien, oder die Inseln des malayischen Archipel, von* A. Bastian. III. *Lieferung. Sumatra und Nachbarschaft.* Berlin, 1886, Pl. II, No. 5.

† Babelon: *Manual of Oriental Antiquities,* p. 37; *Revue archéologique,* 1883 (3e série, t. II), Pl. XX.

performers usually being Hindus of the lower caste. In the villages of southern and central India the watchmen blow it at sunset and at certain hours of the night, like the German *nachtwächter*. In large cities a horn-blower is always attached to the police. There is seldom a guard or detachment of native irregular troops without one. It is employed in all processions, temple services, marriages, and other festive occasions, and at funerals.*

Another trumpet of the same class is the kurna, used chiefly in religious processions, or in festivals in honor of local divinities. Only Brahmins and persons of a certain rank are permitted to use the kurna. It is esteemed by all Brahmins to be the most ancient instrument of music in existence, and the sound of it to be especially pleasing to the gods in various particular ceremonies and at solemn parts of the sacrifices (Cf. Ibid. loc. cit.).

CONCLUSIONS.

In conclusion, the following deductions, which seem to be legitimate, are drawn, though all are not advanced with equal confidence:

(1) The oldest wind instrument used by inland peoples was the horn of an animal, with a natural cavity, and a mouthpiece formed by cutting off the end. Horns which required hollowing came later into use.

(2) These horns were originally used as signals in time of danger and for making announcements in general.

(3) Many of these important announcements had a religious character. The antiquity of the instrument caused its permanent adoption for sacred purposes.

(4) The shofar, speaking especially of the instrument of that name, was originally a wind instrument, made of the horn of a wild goat. Its sacred character may be connected with sacrificial use made of the goat.

(5) The etymology of the word is to be sought in the Assyrian *šappar*, a species of wild goat; *šappartu* (the feminine form) meant originally the horn of the sappar, and it may afterwards have been used for horn in general.

Tribes dwelling near the sea used shells for the same purpose. Biblical Hebrew possesses two other words for the horn of some special animal, *qeren* and *yobel*, which were originally applied to animals. It is interesting in this connection that Hebrew qeren, Latin cornu, and English horn are all used both for a wind instrument and for the horn of an animal.

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* *Cf.* Capt. Meadows Taylor. Proceedings of the Royal Irish Academy, Vol. IX, Pl. 1, p. 110.

LIST OF ILLUSTRATIONS.

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2. Shofar; Italian form. Museum collections.
3. African war horn (antelope). Museum collections.
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5. Siamese copper horn. Museum collections.
6. Large African war horn of ivory, from plaster cast in National Museum. Original in museum of Wesleyan University, Middletown, Conn.
7. Small African war horn of ivory, from plaster cast in National Museum. Original in museum of Wesleyan University, Middletown, Conn.
8. Ivory war horn; Byanzi, Africa. Museum collections.
9. African war horn. Museum collections.
10. Embuchi; ivory war horn, Pala Ballas, Africa. Museum collections.
11. Ivory war horn; west coast of Africa. Museum collections.
12. Ivory war horn; Byanzi, Africa. Museum collections.

PLATE XLVII.

Fig. 1. Shofar, of the great Synagogue, Aldgate, London. Photograph from Hipkins.
2. Shofar, exhibited at Anglo-Jewish exhibition. Supposed to belong to the preëxpulsion period (1290) of the English Jews. From a photograph. (Catalogue No. 2.)
3. Shofar, carved and with inscription. Photographed from Wetzstein's paper.

PLATE XLVIII.

Fig. 1. Shofar of the eighteenth century, from Bagdad. Exhibited at the Anglo-Jewish exhibition. Enlarged from a photograph. (Catalogue 1546.)
2. Shofar, exhibited at the Anglo-Jewish exhibition. Enlarged from a photograph. (Catalogue 1537.)
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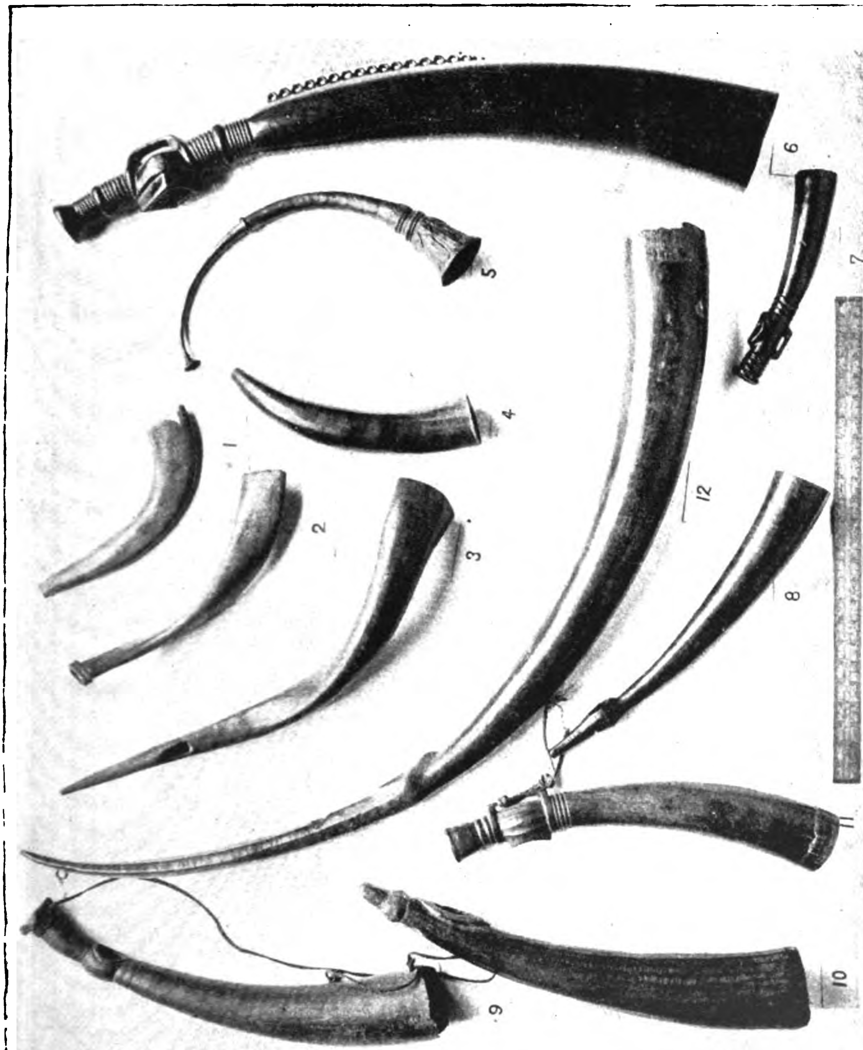
5. Shofar used by the Bene-Israel, a colony of Jews settled in Bombay and neighborhood. It was brought from Aden, and is said to be made of the horn of an animal called the "cudoo." Exhibited at the Anglo-Jewish exhibition. Enlarged from a photograph. (Catalogue 920.)

PLATE XLIX.

Fig. 1. Shofar in possession of Miss Elizabeth F. Aaron, New York. Photograph from the original drawing through the courtesy of the Century Company, New York.
2. Shofar belonging to the Great Synagogue, London. Exhibited at the Anglo-Jewish exhibition. From a photograph. (Catalogue No. 1550.) Inscribed.



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6. Large African war horn of ivory.
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10. Embuchi; ivory war horn, Pala Ballas, Africa.
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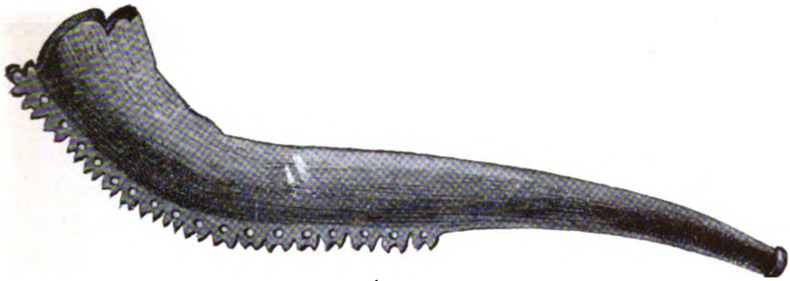

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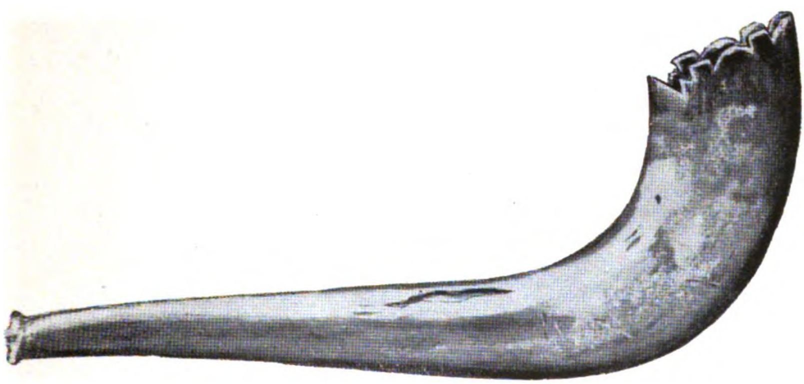

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1. Shofar of the Great Synagogue, Aldgate, London.
2. Shofar, supposed to belong to the preëxpulsion period (1290) of the English Jews.
3. Shofar, carved and with inscription.

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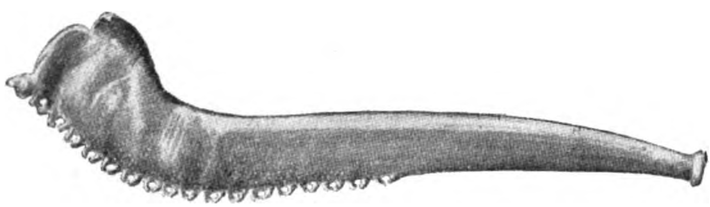

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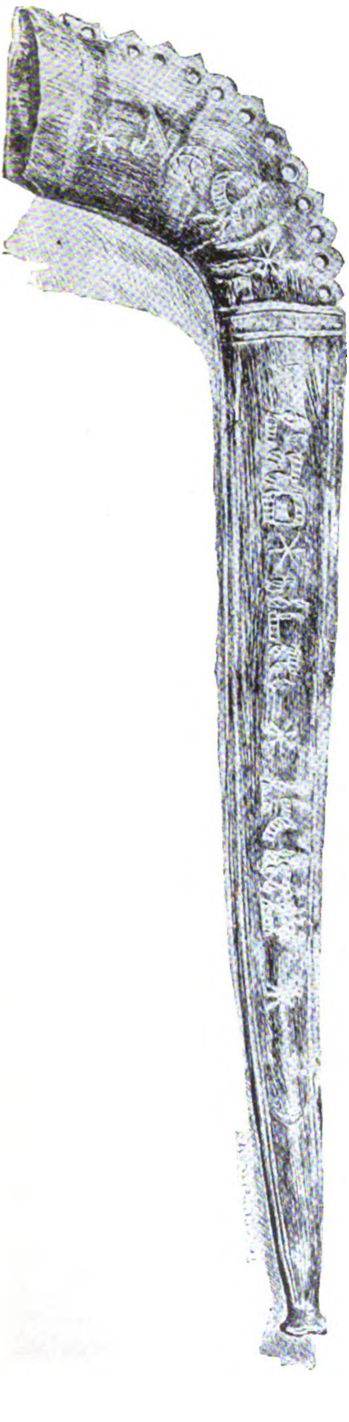
1. Shofar of the eighteenth century, from Bagdad.
2. Shofar exhibited at the Anglo-Jewish exhibition.
3. Shofar (black from age) belonging to the Great Synagogue, London.
4. Shofar exhibited at the Anglo-Jewish exhibition.
5. Shofar used by the Bene-Israel.



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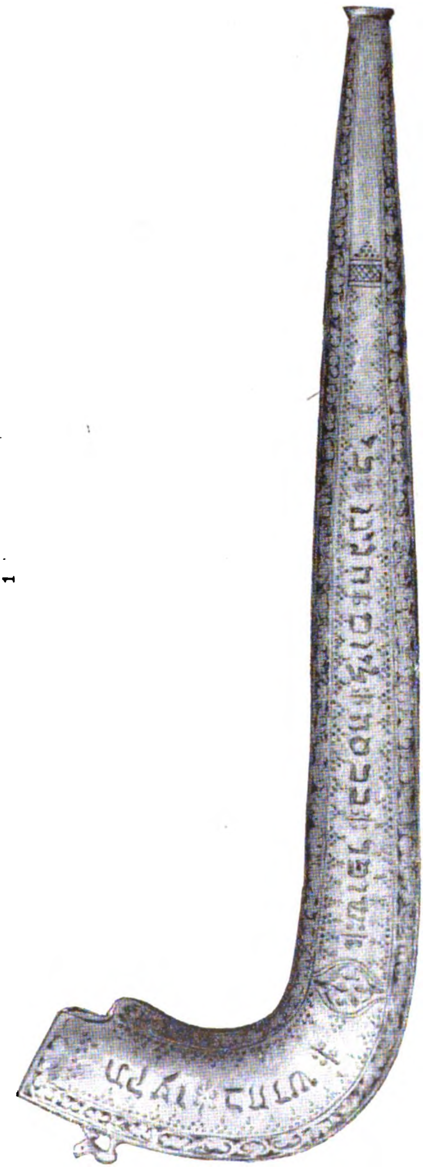

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1. Shofar in possession of Miss Elizabeth F. Aaron, New York.

2. Shofar belonging to the Great Synagogue, London.

LIST OF DIATOMACEÆ FROM A DEEP-SEA DREDGING IN THE ATLANTIC OCEAN OFF DELAWARE BAY BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

BY

ALBERT MANN.

In presenting this list of species of the Diatomaceæ, accompanied with mounted specimens, which I have discovered in the first of the deep-sea Atlantic dredgings submitted to me for examination, I wish to offer some general results of the investigation.

This dredging was taken by the United States steamer *Albatross* at Station No. 2721, being in latitude 38° 56′ 00″ N. and longitude 72° 11′ 30″ W., and in 813 fathoms of water. The species found (numbering 145, and with varieties 156) comprise not only marine forms, but a large number that are known to be fresh-water, and some found hitherto only in a fossil state.

Before treating the material with acids I carefully examined it as it was sent to me, preserved in alcohol, and discovered that none of the frustules contain a particle of endochrome or organic matter. This, taken in connection with the depth of water, the large number of species represented, and the before-mentioned fact that there are many fresh-water and fossil as well as marine forms, makes it evident that the entire deposit is composed of fine detritus gradually sifted down upon the sea bottom and conveyed there by currents from a considerable distance.

The Delaware River has without doubt supplied most of the material of this dredging, as it empties into the ocean almost directly west of the locality where it was taken, and as most of the forms (marine and fresh) are such as are common in rivers and streams of correspondingly temperate latitude.

An interesting corroboration of this is to be found in one of the fossil species, *Navicula Schultzei* Kain. This diatom was originally discovered in material from an artesian well at Atlantic City, N. J., at a depth of 406 feet, by Mr. C. H. Kain, of Philadelphia, Pa., and named by him. The same stratum however, outcrops at several places along the Delaware River watershed, notably at Shiloh, N. J., and this diatom, with, perhaps, *Raphoneis gemmifera* Ehrb., and other of the fossil forms, could have gotten into this dredging in no other way than by being brought by the Delaware River from some of these outcrops. But there are some forms occurring abundantly in this deposit which are essentially tropical; these

may have been conveyed here by the Gulf Stream, which flows northward near this point.

By laborious examination of nearly all the literature on the Diatomaceæ I found it unnecessary to give a new name to a single one of the many species discovered. This is really a cause for congratulation, for, however enticing to the investigator the opportunity of naming "new forms" may be, it is a thing to be avoided whenever possible. All departments of natural science are afflicted with a host of unwarranted names, and none more so than that of the Diatomaceæ, where at least 20 per cent of the generic and specific names are fictitious. For this reason I have been compelled to make, in the pages following, a number of corrections of familiar names.

The entire absence of new species in this gathering is an additional confirmation of the statement that it is entirely the product of transportation; since diatoms found growing at so unusual a depth would have quite certainly supplied some hitherto unknown forms.

Following is a list of genera and species found, together with references to the drawing and descriptions in published works by which they were identified.

Actinocyclus crassus W. S. (Van Heurck's Synopsis, pl. 124, fig. 8. Smith's B. D., pl. 4, fig. 41.) Very scarce.

Actinocyclus Ralfsii W. S. (Van Heurck's Synop., pl. 123, fig. 6.) Common.

The forms here found are somewhat intermediate between the above and *A. Ehrenbergii* Ralfs. In fact, these two species are known to grade into each other by almost indistinguishable forms; so that it is probable they should constitute only varieties of one species.

Actinocyclus Ralfsii, var. **sparsus** (=**Eupodiscus sparsus**, Greg.). (Pritchard's Infusoria, p. 835; Moebius's Plates, pl. 12, fig. 474.) Frequent.

Actinocyclus subtilis Ralfs. (Van Heurck's Syn., pl. 124, fig. 7, pl. 125, figs. 9 and 11.) Scarce.

Actinoptychus hexagonus Grun. (Schmidt's Atlas, pl. 1, fig. 15.) Very scarce.

Actinoptychus splendens Ralfs. (Van Heurck's Syn., pl. 119, figs. 1–4, pl. 120, figs. 1–6.) Frequent.

Actinoptychus undulatus Ehrb. (Schmidt's Atlas, pl. 1, figs. 1–6.) Common.

Amphiprora ornata Bail. (Van Heurck's Syn., pl. 22 bis, fig. 5.) Very scarce.

Amphora bigibba Grun. (Schmidt's Atlas, pl. 25, figs. 69–70.) Scarce.

Amphora cingulata Cleve. (Schmidt's Atlas, pl. 26, fig. 17.) Very scarce.

Amphora cymbiffera Greg. (Schmidt's Atlas, pl. 25, figs. 17–18.) Scarce.

Amphora obtusa Greg. (Schmidt's Atlas, pl. 40, fig. 16.) Scarce.

Amphora porcellus Kitton (=**A. novæ-calidoniæ** Grun.). (Schmidt's Atlas, pl. 39, fig. 15.) Scarce.

Amphora proteus Greg. (Schmidt's Atlas, pl. 27, fig. 3, pl. 28, fig. 9.) Frequent.

Amphora sulcata Breb. (Pritchard's Infusoria, p. 883; "The Lens," pl. 2, fig. 11, and pp. 75–76.) Very scarce.

Asterionella formosa Hassal. (Van Heurck's Syn., pl. 51, fig. 22.) Common.

Asterolampra Marylandica Ehrb. (Moebius's Plates, pl. 32, figs. 1–4.) Scarce.

Asteromphalus Brookei Bail. var. (Schmidt's Atlas, pl. 38, fig. 9.) Frequent.

Although Prof. H. L. Smith's suggestion, to unite the genus *Asteromphalus* with the former genus, is along the line of much needed abridgment; it yet seems that, as most of the genera are now constituted,

there is sufficient difference between these two to warrant their remaining separate.

Asteromphalus flabellatus Grev. (Schmidt's Atlas, pl. 38, fig. 10; Moebius's Plates, pl. 21, fig. 5.) Frequent.

Asteromphalus Shadboldtianus Grev. (Schmidt's Atlas, pl. 38, fig. 17; Moebius's Plates, pl. 33, fig. 19.) Scarce.

Auliscus cælatus Bail. (Schmidt's Atlas, pl. 32, figs. 14–15.) Very scarce.

The only species found of this prolific genus.

Biddulphia aurita Lyngb. (Schmidt's Atlas, pl. 120, figs. 5–10, pl. 122, figs. 1–8.) Common.

Biddulphia Tuomeyii Breb. (Schmidt's Atlas, pl. 118, figs. 1–7, pl. 119, figs. 1–8.) Common.

Chaetoceros coarctata Land. (Lander's Hong Kong, pl. 8, fig. 8, page 79; Cleve's Java, pl. 2, fig. 10.) Frequent.

Chaetoceros varians Land. (=**Bacteriastrum varians**, etc.). (Moebius's Plates, pl. 56, figs. 1–6.) Frequent.

The genus *Bacteriastrum* is rightly included in *Chaetoceros;* different frustules in the same filament often displaying the characteristics of both.

Cocconeis distans Greg. (Pritchard's Inf., pl. 7, fig. 38, page 870.) Scarce.

Cocconeis placentula Ehrb. (Van Heurck's Syn., pl. 30, figs. 26–27; Moebius's Plates, pl. 4, fig. 1.) Frequent.

Cocconeis scutellum Ehrb. (Pritchard's Inf., page 869; Van Heurck's Syn., pl. 29, figs. 1–2.) Common.

The above figures and description by Mr. Ralfs appear sufficient to separate this from *C. distans.*

Coscinodiscus asteromphalus Ehrb. (Schmidt's Atlas, pl. 63, figs. 1–2; pl. 113, fig. 22; Van Heurck's Syn., pl. 130, figs. 1 and 5; Pritchard's Inf., page 828.) Frequent.

Coscinodiscus confusus Rattray. (Schmidt's Atlas, pl. 63, fig. 15.) Frequent.

Coscinodiscus convexus A. S. (Schmidt's Atlas, pl. 60, figs. 13 and 15.) Scarce.

Coscinodiscus decrescens Grun. (Schmidt's Atlas, pl. 61, figs. 8–10.) Frequent.

Coscinodiscus excentricus Ehrb. (Schmidt's Atlas, pl. 58, fig. 49; Van Heurck's Syn., pl. 130, figs. 4 and 8.) Common.

Coscinodiscus lineatus Ehrb. (Van Heurck's Syn., pl. 131, fig. 3.) Frequent.

Coscinodiscus oblongus Grev. (Schmidt's Atlas, pl. 66, figs. 10–11.) Scarce.

Coscinodiscus radiatus Ehrb. (Schmidt's Atlas, pl. 60, figs. 5, 6, 9, 10.) Very common.

Coscinodiscus robustus Grev. (Schmidt's Atlas, pl. 62, figs. 4–6.) Scarce.

Coscinodiscus symbolophorus Grun. (Schmidt's Atlas, pl. 138, figs. 1–3.) Frequent.

Coscinodiscus symmetricus Grev. (Schmidt's Atlas, pl. 57, fig. 27.) Very common.

Coscinodiscus traduceus, var. hispida, Rattray. (Schmidt's Atlas, pl. 57, fig. 38.) Frequent.

Cyclotella physoplea Kg. (Ehrenberg's Mik., Pl. 33, 17, fig. 8; Pritchard's Inf., page 811.) Scarce.

It is very probable that this is only an inner shell of some other species.

Cyclotella striata Grun. (Van Heurck's Syn., pl. 92, figs. 6–10, 12.) Frequent.

Cymatopleura solea W. S. (Van Heurck's Syn., pl. 55, figs. 5–7; Pritchard's Infusoria, pl. 9, fig. 155, page 793.) Very scarce.

The six transverse undulations are absent in this variety. Indeed, they are so frequently absent in specimens of this form, that they

should be dropped as a specific characteristic. The genus ought to be included under *Surirella.*

Cymatosira Laurenziana Grun. (Van Heurck's Syn., pl. 45, fig. 42.) Frequent.

This genus should be, as suggested by Prof. H. L. Smith, united under *Fragilaria*, from which it differs in no important respect. Lyngbye constituted the genus *Fragilaria* in 1819; Grunow that of *Cymatosira* in 1862.

Cymbella cistula Hempr. (Van Heurck's Syn., pl. 2, figs. 12, 13.) Scarce.
Cymbella cuspidata Kg. (Van Heurck's Syn., pl. 2, fig. 3.) Scarce.
Cymbella parva W. S. (Van Heurck's Syn., pl. 2, fig. 14. Schmidt's Atlas, pl. 10, fig. 15.) Frequent.

This is, however, hardly W. Smith's *C. parva* ("*Cocconema parvum*"), as is seen by his figure, pl. 23, fig. 222, and p. 76. It should either receive a new specific name, or be classed as a small form of *C. cymbiformis* E, from which it differs very slightly.

Denticula elegans Kg. (Van Heurck's Syn., pl. 49, figs. 14, 16.) Scarce.
Ditylum (=Triceratium) Brightwellii West. (Van Heurck's Syn., pl. 114, figs 3–9.) Common.

This diatom is evidently a distinct genus, and should be restored with its old name, as suggested by Prof. H. L. Smith. The unscientific genus "*Triceratium*" is quite overcrowded with dissimilar forms without this.

Encyonema prostratum Ralfs. (Van Heurck's Syn., pl. 3, figs 9–11.) Frequent.

As the growth of diatoms in gelatinous tubes or otherwise is no longer considered ground to constitute a genus, this form should be classed under *Cymbella*, from which it differs in no other respect.

Epithemia turgida Kg. (Van Heurck's Syn., pl. 31, figs 1, 2.) Frequent.
Epithemia Westermani Kg. (Van Heurck's Syn., pl. 31, fig. 8. Kutzing's Bac., pl. 5, fig. 12.) Frequent.

This is nothing more than a close variety of *E. turgida* Kg., and should not be made a separate species. William Smith's figure of "*E. Westermanii* Kg." is certainly incorrect. See Smith's B. D., pl. 1, fig 11.

Epithemia zebra Kg. (Van Heurck's Syn., pl. 31, figs. 9–14.) Scarce.
Eunotia pectinalis Rabenh. (Van Heurck's Syn., pl. 33, figs. 15–19.) Frequent.
Euodia (=Hemidiscus) cuneiformis Wall. (Wall, T. M. S., 1860, pl. 2, figs. 3-4, p. 42. Pritchard's Inf., pl. 6, fig. 14.) Very common.

This is probably the *E. gibba* of Bailey. Compare with above Pritchard's Inf., pl. 8, fig. 22, p. 852. It is virtually identical with *E. inornata* of Castricane. See *Challenger* Exp., pl. 12, fig. 1, p. 149. The older name *Euodia* (1859) should take the place of *Hemidiscus* (1860).

Eupodiscus radiatus Bail. (Van Heurck's Syn., pl. 118, figs. 1, 2. Moebius's Plates, pl. 28, fig. 10. Smith's B. D., pl. 30, fig. 255.) Scarce.

This diatom is identical with *Coscinodiscus radiatus* E., except for the ocelli of the former; and as frustules that normally have processes are often destitute of the same, these two forms are suspiciously alike.

Eupodiscus tesselatus Roper. (Van Heurck's Syn., pl. 118, figs. 6–7.) Very scarce.

There is not sufficient warrant for M. Van Heurck according to this form the generic name "*Roperia*."

Fragilaria capucina Desmaz. (Smith's B. D., pl. 35, fig. 296.) Common.

Fragilaria Schwarzii Grun. (Van Heurck's Syn., pl. 44, fig. 24.) Very scarce.

The difference between this and *F. pacifica* Grun. is too slight to warrant their separation.

Gomphonema sphærophorum Ehrb. (Van Heurck's Syn., pl. 23, fig. 30.) Scarce.

This is the same as *G. lagenula* Kg. See Van Heurck's Syn., pl. 25, figs. 8–9. Ralfs rightly unites the two. Pritchard's Inf., p. 889.

Grammatiphora macilenta W. S. (Smith's B. D., pl. 61, fig. 382, p. 43. Van Heurck's Syn., pl. 53, fig. 16.) Frequent.

Hemiaulus polycistinorum Ehrb. (Schmidt's Atlas, pl. 143, figs. 23–29.) Frequent.

Mastogloia apiculata W. S. (Smith's B. D., pl. 62, fig. 387, p. 65.) Very scarce.

This genus should be included under *Cocconeis*. It differs but slightly in the presence of marginal loculi, which are frequently quite indistinct.

Melosira ornata Grun. (Van Heurck's Syn., pl. 91, fig. 20.) Frequent.

Melosira sulcata Kg. (Van Heurck's Syn., pl. 91, fig. 18.) Frequent.

Melosira varians Ag. (Van Heurck's Syn., pl. 85, figs. 11–15.) Frequent.

Navicula abnormis Cast. (Challenger Exp., pl. 28, fig. 19, p. 27.) Frequent.

This diatom is possibly only a variety of *N. apis* Donk. as figured in Schmidt's Atlas, pl. 12, fig. 17, and pl. 69, fig. 41. I have, however, found it to be very constant in form and frequent in this gathering, thus agreeing with the experience of Conte Castracane (p. 27). The name, however, is unfortunate, as it had been bestowed on a totally different diatom by Grunow. See Cleve's (1880) Arctischen, pp. 46, 47. Also Cleve and Möllus Types No. 142.

Navicula Americana E., variety. (Ehrenberg's Mik., pl. 2–2, fig. 16; O'Meara I. D., pl. 30, fig. 30.) Very scarce.

Navicula aspera Ehrb. var. **intermedia** Grun. (Schmidt's Atlas, pl. 48, fig. 14.) Frequent.

Navicula bisulcata Lag. (Schmidt's Atlas, pl. 49, figs. 15, 16.) Scarce.

Navicula borealis Ehrb. (Schmidt's Atlas, pl. 45, figs. 15–21.) Scarce.

Navicula caribæa Cleve. (Schmidt's Atlas, pl. 6, figs. 10–12.) Frequent. See note under next species.

Navicula clavata Greg. (Donkin's B. D., pl. 2, fig. 8; Schmidt's Atlas, pl. 3, fig. 13.) Frequent.

This diatom, of which the typical form and three well-marked varieties are found in this gathering, is frequently confused with the preceding species *N. caribæa* of Cleve. Schmidt, after giving the correct figure for *N. caribæa* in pl. 6, figs. 10–12, applies the same name to the present species, as in pl. 2, fig. 17, and pl. 70, fig. 48. That the true *N. caribæa* is the one figured in pl. 6, figs. 10–12, is proven by the fact that Cleve refers to this figure in his "Vega Diatoms," p. 496.

I must add that it would be better to include *N. clavata* with all its varieties under *N. lyra* Ehrb.

Navicula cluthensis Cleve. (Cleve's (1880) "Arctischen," pl. 2, fig. 49.) Scarce.

Navicula distans W. S. (Schmidt's Atlas, pl. 46, fig. 12.) Common.

This diatom is identical with the figure above referred to, but that it should be given Smith's name of *N.* (*Pinnularia*) *distans* is doubtful. That author was very strict on the point of moniliform costæ, separating *Navicula* from *Pinnularia* on this one characteristic. Hence he would never have called a diatom with the evident naviculoid markings of this one "Pinnularia." Besides, his description of *P. distans* states that the apices are "acute" (p. 56), which is not the case here.

Navicula exemta A. S. (Schmidt's Atlas, pl. 69, figs. 13, 40.) Frequent.

Navicula firma Kg. var. **tumescens** Grun. (Schmidt's Atlas, pl. 49, fig. 10.) Scarce.

Navicula fusca Greg. var. **delicata** A. S. (Schmidt's Atlas, pl. 7, fig. 1.) Scarce.

Though this form is analogous to *N. smithii* Breb., it differs in being not compound punctate in its costæ, but strictly moniliform costate; also in having several rows of costæ at each end of the frustule parallel with the long diameter. Ralfs distinguishes between the above in Pritchard's Inf., p. 898.

Navicula gastrum var. **placentula** Ehrb. (Van Heurck's Syn., pl. 8, figs. 26–28; Cleve's (1880) "Arctischen," pl. 2, fig. 36; Pritchard's Infusoria, p. 900.) Scarce.

Ehrenberg's *N. gastrum* and *N. placentula* are virtually the same diatom. They are considered identical by Ralfs, yet, as *placentula* is generally figured with narrower and more tapering apices than *gastrum*, I have given both names, making the later a variety of the earlier form.

Navicula granulata Breb. (Schmidt's Atlas, pl. 6, figs. 15, 16.) Scarce.

Navicula Hennedyi W. S. (Schmidt's Atlas, pl. 3, figs. 3 and 18.) Scarce.

Navicula humerosa Breb. (Van Heurck's Syn., pl. 11, fig. 20.) Frequent.

Navicula interrupta W. S. (Schmidt's Atlas, pl. 45, fig. 72; Smith's B. D., pl. 19, fig. 189.) Scarce.

Kutzing has given the same name to a wholly different form. See his Bacillaria, p. 100, pl. 29, fig. 93.

Navicula irrorata Grev. (Schmidt's Atlas, pl. 2, figs. 19, 22, 23.) Very scarce.

Navicula lineata Donk. (?) (Schmidt's Atlas, pl. 69, fig. 31.) Scarce.

This diatom, which is accurately illustrated by the above figure, is not the real *N. lineata* of Donkin, as is seen by comparing the above with fig. 8 on pl. 1 of Donkin's "British Diatoms." It is similar to A. Schmidt's *N. digrediens;* but might perhaps receive a new name.

Navicula lyra Ehrb. (Schmidt's Atlas, pl. 2, figs. 16, 24–25, etc. Van Heurck's Syn., pl. 10, figs. 1–2.) Common.

Navicula lyra, var. **dilatata** A. S. (Schmidt's Atlas, pl. 2, fig. 26.) Scarce.

Navicula lyra, var. **elliptica** A. S. (Schmidt's Atlas, pl. 2, figs. 29–34.) Frequent.

These varieties of *N. lyra* Ehrb. are all unimportant.

Navicula major Grun. (Schmidt's Atlas, pl. 42, figs. 8–10. Van Heurck's Syn., pl. 5, fig. 3.) Scarce.

Navicula mesolepta Ehrb., var. **stauroneiformis** Greg. (Van Heurck's Syn., pl. 6, fig. 15.) Very scarce.

Navicula pennata A. S. (Schmidt's Atlas, pl. 48, figs. 41–43.) Frequent.

Navicula prætexta Ehrb. (Schmidt's Atlas, pl. 3, figs. 30–34.) Scarce.

Navicula rhomboides Ehrb. (Van Heurck's Syn., pl. 17, fig. 1.) Scarce.

The making a new genus "*Van Heurckia*" for this diatom is to be deprecated.

Navicula rostellata Kg. (Van Heurck's Syn., pl. 7, figs. 23–24.) Frequent.

This is very near some forms of *N. varians* Greg.; but the costæ do not continue "radiant from central nodule," but midway between it and the apices become strictly transverse.

Navicula Schultzei Kain. ("Atlantic City Diatoms" in the Torry Botanical Bulletin, pl. 89, fig. 2.) Very scarce.

This diatom, though similar to *N. maculata* Edw., is probably distinct. This conclusion is reached, not from drawings, but from a careful comparison and measurement of the original diatoms named.

Navicula serians Kg. (Van Heurck's Syn., pl. 12, fig. 7.) Scarce.

Navicula Smithii Breb. (Van Heurck's Syn., pl. 9, fig. 12; Schmidt's Atlas, pl. 7, fig. 22.) Common.

This beautiful diatom presents several unimportant varieties in this gathering.

Navicula splendida Greg. (Schmidt's Atlas, pl. 13, fig. 32.) Frequent.

Navicula subcincta A. S. (Schmidt's Atlas, pl. 13, fig. 41.) Scarce.

Navicula suborbicularis Greg. (Schmidt's Atlas, pl. 8, figs. 1–6.) Scarce.

Navicula transfuga Grun. (Cleve's "Vega," pl. 35, fig. 15, p. 511.) Scarce.

Navicula Weissflogii A. S. (Schmidt's Atlas, pl. 12, figs 26, 32.) Very scarce.

Nitzschia amphionys Grun. (Van Heurck's Syn., pl. 56, figs. 1–6.) Frequent.

The creating a new genus, "Hantzschia," for this diatom is wholly unnecessary.

Nitzschia gracilis Hantzsch. (Van Heurck's Syn., pl. 68, fig. 11.) Frequent.

Nitzschia marina Grun. (Van Heurck's Syn., pl. 57, figs. 26–27.) Very common.

The variety found in this gathering differs from the type in a decidedly coarser marking, the monils being evident under a quite low power of magnification. Its apices also are more regularly tapered. It is found in an endless variety of lengths, but retains a constant width in all cases. It is probably the same as "*Synedra atlantica*" of Castracane; see *Challenger* Exp., p. 53, pl. 25, fig. 16.

Nitzschia marginulata, var. didyma Grun. (Van Heurck's Syn., pl. 58, fig. 14.) Scarce.

Nitzschia palea W. S. (Van Heurck's Syn., pl. 69, figs. 22c. 29, 31.) Frequent.

Nitzschia panduriformis Greg. (Van Heurck's Syn., pl. 58, figs. 1–6.) Frequent.

Nitzschia punctata Grun. (Van Heurck's Syn., pl. 57, fig. 2.) Very scarce.

This is W. Smith's "*Tryblionella punctata*." It very evidently belongs to the *Nitzschiæ*.

Nitzschia salinarum Grun. (Van Heurck's Syn., pl. 57, fig. 18.) Scarce.

It is doubtful if the separation of this form from Smith's *N.* (*Tryblionella*) *levidensis* is justifiable.

Nitzschia sigma W. S. (Van Heurck's Syn., pl. 65, figs. 7–8.) Frequent.

Nitzschia thermalis Grun. (Van Heurck's Syn., pl. 59, figs. 15–19.) Scarce.

Pleurosigma affine Grun. (Van Heurck's Syn., pl. 18, fig. 9.) Frequent.

Pleurosigma inflatum Shad. (Mœbius's Plates, pl. 3, fig. 9. Pritchard's Inf., p. 918.) Common.

Pleurosigma Kützingii Grun. (Van Heurck's Syn., pl. 21, fig. 14.) Frequent.

This is certainly identical with *P. gracilentum* Raben., but the suggestion in Habirshaw's Catalogue, and in Cleve's (1880) "Arctischen," that it is a variety of *P. Spencerii* Grun., is probably incorrect. Great

similarity is displayed in some figures of these two forms, as in those of Van Heurck, but an examination of the diatoms will disclose a difference too wide to admit of their bearing the same name.

Podosira compressa West. (Moebius's Plates, pl. 34, fig. 11. Pritchard's Inf., pl. 8, fig. 34, pp. 15 and 938.) Very scarce.

This genus and *Hyalodiscus* need to be united.

Podosira maculata W. S. (Smith's B. D., pl. 49, fig. 328, p. 54. Schmidt's Atlas, pl. 139, fig. 7.) Common.

Pyxilla Baltica Grun. (Van Heurck's Syn., pl. 83, figs. 1, 2.) Frequent.

Raphoneis amphiceros E. (Van Heurck's Syn., pl. 36, figs. 22–28, pl. 116, fig. 17.) Frequent.

Raphoneis amphiceros, var. rhombica Grun. (Van Heurck's Syn., pl. 36, figs. 20–21. Moebius's plates, pl. 4, fig. 10.) Scarce.

Grunow has placed the *R. rhombus* of Roger as a variety of *amphiceros*, from which it differs only slightly.

Raphoneis gemmifera Ehrb. (Pantoesek's Hung., pl. 12, fig. 104, etc.) Very common.

Raphoneis surirella Grun. (Van Heurck's Syn., pl. 36, figs. 26–27B.) Frequent.

Rhabdonema minutum Kg. (Van Heurck's Syn., pl. 54, fig. 21.) Frequent.

Rhizosolenia styliformis Bright. (Van Heurck's Syn., pl. 79, figs. 1–5.) Very scarce.

Schizonema vulgare Thw. (Van Heurck's Syn., pl. 17, fig. 6.) Scarce.

Were the genus *Schizonema* not a fictitious one it would be well to take this form out of it, as it has no structural unity with any other members of that genus. But *Schizonema* ought to be relegated to *Navicula*, where it belongs.

Stauroneis anceps Ehrb. (Van Heurck's Syn., pl. 4, figs. 4–8.) Scarce.

Stauroneis Phœnicenteron Ehrb., var. **gracilis** (=**S. gracilis** W. S.). (Smith's B. D., pl. 19, fig. 186. Van Heurck's Syn., pl. 4, fig. 2.) Frequent.

Stauroneis Smithii Grun. (Van Heurck's Syn., pl. 4, fig. 10.) Very scarce.

Wm. Smith figures this correctly, pl. 19, fig. 193, but incorrectly calls it "*S. linearis* E." The latter is given by Van Heurck, pl. 4, fig. 8, as a variety of *S. anceps*. Grunow has named it after the first author, giving its correct figure. It seems to be truly hyaline.

Stephanodiscus Hantzschianus Grun. (Cleve's (1880) Arctis., pl. 7, fig. 131. Van Heurck's Syn., pl. 95, fig. 10.) Very scarce.

Stephanogonia Danica Grun. (Van Heurck's Syn., pl. 83 bis., figs. 7–8.) Scarce.

The form here found is a variety of the above, its ridged lines, radiating from the central apex, being more numerous and less plainly visible.

Stephanopyxis corona Ehrb. (Schmidt's Atlas, pl. 123, figs. 10–17.) Scarce.

Stephanopyxis turris Ralfs. (Van Heurck's Syn., pl. 83 ter., fig. 12; Schmidt's Atlas, pl. 130, figs. 42–43; Pritchard's Inf., pl. 5, fig. 74, and p. 826.) Frequent.

Surirella minuta Breb. (Van Heurck's Syn., pl. 73, figs. 9–10.) Frequent.

Surirella ovalis Breb. (Van Heurck's Syn., pl. 73, figs. 2–4.) Common.

Surirella recedens A. S. (Schmidt's Atlas, pl. 19, figs. 2–4, pl. 24, fig. 28.) Scarce.

Surirella tenera Greg. (Schmidt's Atlas, pl. 23, figs. 7, 9.) Scarce.

Syndendrium diadema E. (Moebius's Plates, pl. 8, figs. 49–52.) Frequent.

Synedra delicatissima W. S., var. **mesoleia** Grun. (Van Heurck's Syn., pl. 39, fig. 6.) Scarce.

Synedra pulchella Kg. (Van Heurck's Syn., pl. 41, figs. 1–8.) Frequent.

Synedra ulna Ehrb. (Van Heurck's Syn., pl. 38, fig. 7.) Scarce.

Synedra ulna, var. **subæqualis** Grun. (Van Heurck's Syn., pl. 38, fig. 13.) Scarce.

This, put as a doubtful species by Van Heurck, is, as he suggests, only a variety of *ulna*.

Synedra ulna, var. **spathulifera** Grun. (Van Heurck's Syn., pl. 38, fig. 4.) Scarce.

The same is true in this case also.

Tabellaria fenestrata Kg. (Smith's B. D., pl. 43, fig. 317, p. 46.) Common.

Triceratium acutum Ehrb. (Van Heurck's Syn., pl. 108, fig. 1.) Scarce.

This genus, made up principally of triangular and quadrangular forms of *Biddulphia*, is so heterogeneous in character that it should be abandoned, as Prof. H. L. Smith suggests, and its forms assigned to their proper scientific genera.

Triceratium alternans Ehrb. (Schmidt's Atlas, pl. 78, figs. 9–17.) Very common.

Triceratium bicorne Cleve. (Schmidt's Atlas, pl. 78, figs. 24–25.; Cleve's W. India Diat. pl. 5, fig. 30, p. 17.) Very scarce.

This diatom is an evident *Biddulphia*, as was suspected by Cleve when he named it. In general appearance it is much like the abnormal *B. reticulata* figured in Schmidt's Atlas, pl. 78, fig. 21; but under high magnification it fails to show the reticulating secondary markings characteristic of that species.

Triceratium cinnamomeum Grev. (Moebius's Plates, pl. 47, fig 12; Schmidt's Atlas, pl. 151, figs. 23–27; Van Heurck's Syn., pl. 126, fig. 1.) Very scarce.

The specific name is variously spelled *cimamomeum*, *cinnamoneum*, and as above. Van Heurck includes it in *Cestodiscus*, to which it presents doubtful analogies.

Triceratium inelegans Grev. (Moebius's Plates, pl. 71, fig. 21; Van Heurck's Syn., pl. 110, figs. 2–5.) Common.

See note under *T. punctatum.*

Triceratium ornatum Shad. (Moebius's Plates, pl. 16, figs. 10–14; Schmidt's Atlas, pl. 98, figs. 7–13.) Scarce.

This is Wallisch's *Amphitetras pentacrinus*, and is essentially the same as *T. biquadratum* Janisch, *T. junctum* A. S., *T. Balearicum* Cleve, and a large number of unimportant varieties, as "var. *hirsuta*," in Challenger Exp., pl. 23, fig. 9. This diatom is remarkably variable, even in a single gathering, which is probably the reason for the number of pseudonyms created for it. The name "*pentacrinus*" is deceptive.

Triceratium punctatum Bright. (Moebius's Plates, pl. 9, fig. 18. Van Heurck's Syn., pl. 109, figs. 6, 9–10.) Very common.

The strict types of both this and *T. inelegans*, Grev. are found in this gathering and many intermediate forms, which make it evident that these two close species are merely varieties of one. Though the name "*inelegans*" is not well chosen for these forms, it should be preferred to "*punctatum*," as Wallisch has applied the latter to a wholly different diatom. See Moebius's Plates, 31, fig. 21.

Triceratium Weissii, Grun. (Schmidt's Atlas, pl. 95, figs. 2–12.) Scarce.
Trinacria excavata Heib. Forma tetragona. (Schmidt's Atlas, pl. 152, figs. 26–28.) Scarce.

The necessity noted under *Triceratium* for doing away with the genus also exists in this case. *Trinacria* should be united with *Solium* and *Hemiaulus* and be given either the last name, as the oldest (1840 by Ehrenberg), or *Solium*, as the most suggestive.

A number of sports and abnormalities of some of the species named were found in this gathering, but have not been described, as they have no bearing on classification.

NEWARK, N. J., March, 1892.

DESCRIPTION OF A NEW SPECIES OF CYPRINOID FISH, COUESIUS GREENI, FROM THE HEAD WATERS OF FRAZER RIVER IN BRITISH COLUMBIA.

BY

DAVID S. JORDAN.

COUESIUS GREENI, sp. nov.

Head $4\frac{1}{10}$ in length; depth, $4\frac{1}{10}$. D. 8; A. 8. Scales, 10–57–7. Teeth, 2–4–4–2. Length of largest specimen, $6\frac{1}{8}$ inches.

Body robust, the back convex before the dorsal, the profile of head straight and rather steep, the space between eyes broad and flattish, $3\frac{1}{4}$ in head. Snout bluntish, but rather long, $3\frac{3}{4}$ in head; the premaxillary just above the level of the lower part of the pupil; maxillary reaching almost to the front of the orbit, $3\frac{3}{4}$ in head; barbel well developed, not quite at the end of the maxillary; its length considerably less than that of pupil. Mouth moderately oblique, the lower jaw slightly included. Dorsal fin inserted behind the base of the ventrals and behind the middle of the body at a point midway between the preopercle and the base of the caudal, the fin of moderate height. Pectoral shortish, $1\frac{1}{2}$ in head, ventrals nearly 2. Caudal well forked, the lobes equal, $1\frac{2}{5}$ in head. Scales larger than in related species, scarcely reduced forward and but little smaller on the back than on the sides; 36 scales in front of the dorsal. Color dark olive above, the sides reddish, silvery. Very slight traces of a lateral band, a dark streak below the eye undulating and extending from the side of the upper jaw to the opercle. Lining of shoulder gradually dusky. Fins without definite markings, the upper somewhat dusky.

This species is related to *Couesius plumbeus* of the Upper Missouri and Lake Superior region, from which species it differs in the larger size of the scales and in some details of form. The head is especially large and heavy.

Two specimens of this species were received from Mr. Ashdown H. Green, of Victoria; the larger specimen, measuring $6\frac{1}{8}$ inches, is in the museum of the Leland Stanford Jr. University; the second specimen, measuring $3\frac{5}{8}$ inches in length, has been sent to the U. S. National Museum. The specimens were obtained by Mr. Green in Stuarts Lake, near Fort St. James, in British Columbia. This lake is near the head waters of Frazer's River. Mr. Green says: "I am told that this is the only lake, in that part of the country at least, where these fishes are found."

We received at the same time from Mr. Green a specimen of the small land-locked salmon, *Oncorhynchus kennerlyi*, obtained by him in Shawnigan Lake. This lake lies about 20 miles north of Victoria and has no connection with the sea.

I have also received from Mr. Green the skin of a large, white sea bass, *Cynoscion nobilis*, taken in Sooke Harbor, 20 miles east of Victoria. The fish weighed 45 pounds. It was found on the top of the water in distress, its pectoral and caudal fins having been bitten by the dog-fish sharks. This species had not previously been taken much north of San Francisco, and its occurrence in Puget Sound is remarkable.

PALO ALTO, CAL., *February 1, 1893.*

NOTE ON THE WALL-EYED POLLACK (POLLACHIUS CHALCOGRAMMUS FUCENSIS) OF PUGET SOUND.

BY

DAVID S. JORDAN AND CHARLES H. GILBERT.

Mr. David H. Hume, a fisherman of Tacoma, Wash., wrote to us recently asking for information concerning a fish which he called "Wall-eyed cod," and which has appeared in abundance in Puget Sound about Seattle. At our request, Mr. Hume sent a number of specimens of the fish to the museum of the Leland Stanford, Jr., University, from which one has been sent to the U. S. National Museum.

The wall-eyed cod proves to be specifically identical with the common pollack of Alaska, *Pollachius chalcogrammus*. These specimens from Seattle, however, differ notably from any which we have seen from Alaska, in the fact that the fins are all lower, and that there are fewer rays than in the Alaskan specimens, and that the color is nearly uniformly sooty, with the dark markings of the Alaskan fish either entirely obliterated or very faintly shown.

These characters would seem at first sight to indicate specific difference; but as we find more or less variation, it is probably safe to regard the Puget Sound fish as representing a southern variety, which may be called *Pollachius chalcogrammus fucensis*.

In the fish from Tacoma the color is nearly plain sooty, with no cross streaks, and with generally only a trace of a pale lateral streak along the side; on the head are some diffuse dark spots; the fins are all dusky. The dorsal fins are low, the longest ray of the first dorsal being from $2\frac{1}{5}$ to $2\frac{1}{3}$ in head; the pectoral is short, from $1\frac{1}{2}$ to $1\frac{2}{3}$ in head; caudal is subtruncated, its lobes scarcely acute. The fin rays in four specimens are as follows: (1) D. 10–15–17; (2) D. 11–15–16; (3) D. 10–14–16; (4) D. 12–13–17; the average of all specimens, D. 11–14–16. Anal fins, (1) A. 18–16; (2) A. 19–18; (3) A. 16–19; (4) A. 19–19; the average of all specimens, A. $17\frac{1}{2}$–18. The band of teeth in the premaxillary is wider than in the Alaskan specimens, and the band is widened at the anterior end.

In the true *chalcogrammus* from Alaska, taking specimens of about the same size, we find that the body is more elongated, the nose sharper, the eyes a little larger, the premaxillary band of teeth narrower and narrowed in front toward the median line, the coloration is paler, the

sides being marked with peculiar, short, irregular, vertical, dark cross streaks and a more or less obscure, pale, lateral streak irregular in form. The fins are all higher, the first dorsal averaging 1$\frac{5}{8}$ in head, the pectoral 1$\frac{1}{3}$ to 1$\frac{2}{5}$; the caudal is distinctly forked with sharp lobes. The fin rays of three specimens are, (1) D. 14–17–19; (2) D. 13–15–19; (3) D. 13–16–20; the average of all, D. 13$\frac{1}{2}$–16–19$\frac{1}{2}$. Anal rays, (1) A. 20–20; (2) A. 19–20; (3) A. 19–20; average of all, 19$\frac{1}{2}$–20$\frac{1}{2}$.

PRELIMINARY REPORT ON THE MOLLUSCAN SPECIES COLLECTED BY THE UNITED STATES SCIENTIFIC EXPEDITION TO WEST AFRICA, IN 1889–'90.

BY

ROBERT E. C. STEARNS, Ph. D.,

Adjunct Curator of the Department of Mollusks.

By an act of Congress provision was made to defray the expense of sending a scientific expedition to the west coast of Africa for the purpose of observing the total eclipse of the sun, occurring on December 22, 1889. In accordance with the recommendations of a board appointed by the Chief of the Bureau of Navigation to devise plans, etc., the details of the expedition were arranged. Through the courtesy of Prof. David P. Todd, of Amherst College, Massachusetts, in charge of the expedition, arrangements were made whereby Mr. W. Harvey Brown and Mr. Arthur H. Brown, of the U. S. National Museum, were appointed acting and assistant naturalists, to accompany the expedition in the interest of the Museum, for the purpose of making collections of natural history objects, especially fishes and mammals.

The expedition sailed from New York on October 16, 1889, on the United States steamer *Pensacola.*

I am indebted to Prof. Todd for the following data as to the points touched at by the expedition, and the dates of arrival and departure:

Localities.	Arrived.	Departed.
Horta, Fayal, Azores	Nov. 2, 1889	Nov. 3, 1889
Porto Grande, St. Vincent, Cape Verde	Nov. 10, 1889	Nov. 12, 1889
Free Town, Sierra Leone	Nov. 18, 1889	Nov. 20, 1889
Elmina Gold Coast	Nov. 26, 1889	Nov. 28, 1889
St. Paul de Loando, Angola	Dec. 6, 1889	Jan. 6, 1890

Here the naturalists were in the interior for nearly a month. After leaving the latter place on the 6th of January, the next point reached was Cape Town, and the arrivals and departures were as follows:

Localities.	Arrived.	Departed.
Cape Town, South Africa	Jan. 17, 1890	Feb. 6, 1890
St. Helena, South Atlantic	Feb. 20, 1890	Mar. 10, 1890
Ascension, South Atlantic	Mar. 16, 1890	Apr. 8, 1890
Bridgetown, Barbados	Apr. 28, 1890	May 10, 1890
Bermuda	May 18, 1890	May 19, 1890

At the latter place the naturalists did not land, owing to quarantine restrictions. The expedition arrived home at New York on the 23d of May, 1890.

As far as Cape Town the collections were made conjointly by the acting and assistant naturalists; at Cape Town Mr. Arthur H. Brown was detached from the expedition to go into the interior.

Class PELECYPODA.

Order PRIONODESMACEA.

Suborder OSTRACEA.

Genus **OSTREA** Linné.

1. **Ostrea mordax** Gould.

One specimen. Ascension Island (Mus. No. 125410).

A single characteristic example.

2. **Ostrea frons** Linné.

Odd valves, beach. Porto Grande (Mus. No. 125318).

Also occurs at various places in east and west Florida, Florida Keys, West Indies, and Barbados.

Suborder PECTINACEA.

Family SPONDYLIDÆ.

Genus **SPONDYLUS** Linné.

3. **Spondylus gæderopus** Linné.

Three valves, beach. Porto Grande (Mus. No. 125583).

4. **Spondylus imbutus** Reeve.

One example, dredged. Ascension Island (Mus. No. 125411)

A small, fresh specimen of the above was obtained from a depth of 40 fathoms.

Family PECTINIDÆ.

Genus **PECTEN** Müller.

5. **Pecten miniaceus** Reeve.

Three odd valves. Fayal (Mus. No. 125284).

A very pretty species.

Suborder MYTILACEA.

Family AVICULIDÆ.

Genus **PERNA** Bruguiere.

6. **Perna perna** Linné.

? = *P. dentiferus*, var. Krauss.

Three specimens, valves. Ascension Island (Mus. No. 125403).

The *dentiferus* of Krauss is probably a variety of the Linnean species; it has a somewhat aviculoid shape.

7. Perna Chemnitziana Orbigny.

Several specimens, Porto Grande (Mus. No. 125355).

Variable in form, and perhaps connecting with the previous species.

Family MYTILIDÆ.

Genus MYTILUS Linné.

8. Mytilus edulis Linné.

One specimen, Cape Town; (Mus. No. 125379).

A solitary example of small size, only 18 millimeters in length, of this common and widely distributed form.

9. Mytilus magellanicus Chemnitz.

Several specimens. Cape Town (Mus. No. 125368).

The shells collected at this place by the expedition that I have labeled as above, upon comparison with examples of the same size from New Zealand and Kerguelen Island, prove to be identical. The larger individuals measure 39 to 40 millimeters, from that to 9 millimeters or less in length.

10. Mytilus atropurpureus Dunker.

Many fresh specimens. Fayal (Mus. No. 125300).

These fine living examples show a rich purple seminacreous iridescence on the interior surface of the valves, unusually brilliant for marine mussels.

11. Mytilus ovalis Lamarck.

Several examples. Porto Grande (Mus. No. 125330).

Genus LITHOPHAGUS Muhlfeldt.

12. Lithophagus aristatus Solander.

= *L. caudigera* Lamarck.

Two specimens. Porto Grande (Mus. No. 125,400).

Genus DREISSENSIA Van Beneden.

13. Dreissensia africana Van Ben.

Numerous examples, living. Ashantee (Mus. No. 125334).

Many specimens of the above, separate, and a large colony attached to a twig, numbering probably as many as a hundred individuals.

Family UNIONIDÆ.

Genus **UNIO** Retz.

14. Unio gaboonensis Kuster.

A few examples. Cunga (Mus. No. 125417).

Specimens of this species were detected in a pond near this place.

Suborder ARCACEA.

Family ARCIDÆ.

Genus **ARCA** Lamarck.

Section ARCA Lamarck.

15. Arca Noæ Linné.

One right valve, beach. Porto Grande (Mus. No. 125348).

This is a widely distributed form. I have collected it on the west coast of Florida; it is found on the Atlantic coast of North America as far north as Hatteras; it occurs in the Florida Keys, the West Indies, the Bermudas, Carthagena, and probably throughout the Antillean-Caribbean region, as well as in Europe.

16. Arca tetragona Poli.

? = *A navicularis* Bruguiere.

Porto Grande (Mus. No. 125352); Ascension Island (125402).

A curious and variable form, offering extraordinary inducements to manufacturers of species. Two of the examples are from the latter locality.

Section BARBATIA Gray.

17. Arca lactea Linné.

? = *A. striata* Reeve.

One specimen (Mus. No. 125406); Ascension Island.

Reported also from the Polynesian Islands.

Section ANADARKA Gray.

18. Arca holoserica Reeve.

One right valve, beach. Porto Grande (Mus. No. 125351).

This widely distributed form also occurs in the Australasian and Indo-Pacific seas.

Section SCAPHARCA Gray.

19. Arca rhombea Born.

Three odd valves, beach. Porto Grande (Mus. No. 125340).

Section SENILIA Gray.

20. Arca senilis Linné.

Many valves, beach; one live specimen. Porto Grande (Mus. Nos. 125329, 125366); Ashantee (Mus. No. 125335); Free Town (Mus. No. 125408).

Valves only from Porto Grande and Free Town. The only live example of this strongly characterized form is the Ashantee specimen. Externally it resembles a *Cardita* rather than an Ark-shell.

The Free Town (Sierra Leone) examples, valves only, are in a semifossilized state, the surface somewhat decomposed. The general facies is much modified and somewhat misleading through weathering; this action of the elements, however, has exposed the hinge area, which exhibits the development and final growth of the hinge teeth. The various stages may be seen between the upper line of the hinge and the under side of the beak or umbo, in close linear grooving. These caused me at first to think that such valves belonged to some other species.

Genus **PECTUNCULUS** Lamarck.

21. Pectunculus violescens Lamarck.

+ *P. stellatus* Lamarck.

Three odd valves, beach. Porto Grande (Mus. No. 125309).

Order TELEODESMACEA.

Suborder CARDITACEA.

Family CARDITIDÆ.

Genus **CARDITA** Bruguiere.

22. Cardita ajar Bruguiere.

One left valve, beach. Porto Grande (Mus. No. 125347).

Suborder LUCINACEA.

Family LUCINIDÆ.

Genus **LORIPES** Poli.

23. Loripes lacteus Linné.

Several odd valves. Porto Grande (Mus. No. 125301).

Family DIPLODONTIDÆ.

Genus **DIPLODONTA** Turton.

24. Diplodonta rotundata Montfort.

One right valve. Fayal (Mus. No. 135289).

This species occurs at many places on the shores of the Mediterranean to moderately deep water; its distribution extends northerly into British waters.

Suborder CARDIACEA.

Family CARDIIDÆ.

Genus CARDIUM Lamarck.

25. Cardium ringens Chemnitz.

Four odd valves, beach. Porto Grande (Mus. No. 125341); Ashantee (Mus. No. 125339).

Three perfect valves of as many individuals were found at the latter place. The Porto Grande specimen was a single right valve, beach.

Suborder VENERACEA.

Family VENERIDÆ.

Genus VENUS Linné.

26. Venus striata Gray.

One right valve, Ashantee (Mus. No. 125321).

27. Venus rugosa Deshayes.

One left valve, beach. Porto Grande (Mus. No. 125350).

Genus CYTHEREA Lamarck.

Subgenus CALLISTA Mörch.

28. Callista chione Lamarck.

One left valve of a young shell. Fayal (Mus. No. 125286).

Genus DOSINIA Scopoli.

29. Dosinia fibula Reeve.

+*Dosinia torrida* Reeve.

Several valves, beach. Porto Grande (Mus. No. 125391).

The following African species are described and figured in Reeve's Monograph of Artemis=Dosinia.

A. fibula Reeve, *A. africana* Gray, *A. radiata* Reeve, *A. Orbignyi* Dunker, *A. torrida* Reeve. To these should be added *A. isocardia* Dunker, and *A. hepatica* Philippi.

Of the foregoing *fibula* and *torrida* are the same without doubt. *Orbignyi*, *africana*, and *hepatica* are also one and the same. The three last are characterized by their authors as exhibiting more or less coloration in the region of the beaks, and upon the inner side of the valves, while *torrida* and *fibula* are white only. While all of these five alleged species vary much in outline, there is no special difference

otherwise than the color character above mentioned, and that is of little importance. Reeve says of his *torrida*, which it will be observed is one of the all-white forms, that it is "concentrically sculptured with fine cord-like striæ, after the manner of *A. Orbignyi*." The roundness or sharpness of the striæ varies more or less in all. The depression of the lunule also varies somewhat, but is usually rather deeply sunken. In all, the closeness, definition, or sharpness of the concentric striæ, is greater toward the anterior and posterior edges of the valve than in the central portion or area. The hinge characters are the same in all, and the interior of the valves are alike in the shape or outline, angle and depth of the sinus, and muscular scars. The valves in all of these, whether young or old, large or small examples, are heavy, solid, and thick, with thick hinge margins and long and rather deeply scarped ligamental area.

The foregoing critical comparison, it will be noticed, practically unites the five so called species, the only differences being those of color, and the greater or less roundness, evenness, or sharpness of the concentric liræ. Now, variation in these characters, it is well known, is a local matter dependent upon or affected by local causes or conditions, such as the character of the sea bed at the spot from which the specimens were obtained. Where the sea bed is nearly clear sand without mud, gravel, etc., the shells are whiter, more evenly and regularly sculptured, with a more porcellaneous surface than from localities where gravel, mud, and clay prevail. The presence of mud, particularly clayey mud, has much to do with the coloration or staining of the shell.

Any person who has collected the hard-shell clam *Venus mercenaria* of the Atlantic seaboard, at many or different places throughout the range of said species, or the *Mactra* or *Mya* of the same faunal region, must have noticed the relation of color to the character of the sea bed. Convexity is another somewhat variable factor, some examples being more tumid than others.

Reeve's *radiata* is no doubt a distinct form, though *isocardia* is doubtfully distinct, and may hereafter, with abundant material for comparison, be regarded as a synonym.

30. **Dosinia Orbignyi** Dunker.

= *D. africana* Gray.
= *D. hepatica* Philippi.

Many odd valves. Porto Grande (Mus. No. 125385). Separable from *fibula*, etc., only by the color stain—no doubt the same species.

31. **Dosinia isocardia** Dunker.

One left valve, beach. Porto Grande (Mus. No. 125388).

Suborder TELLINACEA.

Family DONACIDÆ.

Genus DONAX Linné.

32. **Donax rugosus** Linné.

Numerous examples. St. Paul de Loando (Mus. Nos. 125413, 125414, 125415, 125416, 125418, 125419). Porto Grande (Mus. No. 125399).

The large number of this attractive form collected at St. Paul has enabled me to select an extensive and beautiful series. The valves are sometimes white with purple rays and zones, again white, or yellowish orange, with broad rays of purple; sometimes light purple with darker purple rays and zones, and some examples exhibit a purplish ground with a glaze of sienna yellow, overlaying and toning the color beneath. The interior of the valves is often white, or white rayed with purple or pink and frequently dark purple with the edge of the valves white rimmed. One beautiful example is of a clear delicate pink, tinged slightly with yellow, bounded toward the ventral edge by a broad band of deep rose pink.

Family TELLINIDÆ.

Genus **TELLINA** Linné.

33. **Tellina madagascariensis** Gmelin.

Odd valves. Porto Grande (Mus. No. 125365).

One right and two left valves of this rather solid species; these valves are of a light rose-pink color intensified toward the beaks, and the surface is sculptured by fine incremental and closely set radiating lines.

34. **Tellina incarnata** Linné.

One left valve. Fayal (Mus. No. 125285).

Suborder **MACTRACEA.**

Family MACTRIDÆ.

Genus **MACTRA** Linné.

35. **Mactra Adansonii** Philippi.

One right valve. Porto Grande (Mus. No. 125356).

This is a very pretty and externally quite unmactra-like species, with color markings and a general facies recalling *Mactra stultorum* of the Mediterranean Sea.

Class GASTROPODA.

Subclass ANISOPLEURA.

Superorder EUTHYNEURA.

Order OPISTHOBRANCHIATA.

Suborder TECTIBRANCHIATA.

Family BULLIDÆ.

Genus **BULLA** Linné.

36. **Bulla striata** Bruguiere.

Many specimens. Porto Grande (Mus. No. 125303).

Several examples; solid, heavy beach shells; a widely distributed form. Inhabits the Mediterranean, Adriatic, and Black seas; and Drouet has recorded it from the Azores. * * * Also at Faro in Algarve, where McAndrew procured it (Jeffreys).

Family APLYSIIDÆ.

Genus **APLYSIA** Linné.

37. Aplysia sp.

Two examples in alcohol. Porto Grande, St. Vincent.

Order PULMONATA.

Suborder STYLOMMATOPHORA.

Family LIMACIDÆ.

Genus **ZONITES** Montfort.

38. Zonites cellarius Müller.

One specimen (Mus. No. 125298). Fayal.

The above species also occurs in the British Isles, and is found from Finland to Algeria and Sicily, according to Jeffreys; also in Madeira and the Canaries.

Family HELICIDÆ.

Genus **PATULA** Held.

39. Patula rotundata Müller.

Two specimens (Mus. No. 125295). Fayal.

Ranges from the most northern extremity of Great Britain to the Channel Isles; from Russia and Finland to Sicily and the Azores. (Jeffreys.)

Section LEPTAXIS.

40. Helix (Leptaxis) caldeirarum M. and D.

Three specimens, dead. Fayal at Horta (Mus. No. 125293). The examples, though dead, were in fair condition.

Section CARACOLINA Beck.

41. Helix (Caracolina) barbula Charp.

Two specimens, dead (Mus. No. 125294). Fayal. Found also in Portugal.

Section FRUTICICOLA Held.

42. Helix (Fruticicola) similaris Férussac.

Numerous specimens (Mus. No. 125409). Green Mountain, Ascension Island.

The above is represented by many examples, banded and otherwise, pale to dark horn color. This is another widely distributed form that has almost, if not quite, "put a girdle around the earth." The National collection contains numerous examples from Barbados, Mexico, Brazil at Rio Janeiro, Pegu, and upper Burmah and Bombay in India; the Sandwich Islands, at Singapore and the islands of Mauritius and Java in Polynesian and Indo-Pacific waters, and from Canton, Hong-kong and Whampoa in China. It has also been found at the Seychelles.

Section **EUPARYPHA** Hartman.

Helix (Euparypha) pisana Müller.

Numerous examples. Fayal (Museum No. 125278); Cape Town (Museum No. 125393).

A widely distributed species, occurring in England, France, Portugal, in the Canary Islands, and probably elsewhere, as well as at the localities first given herein. The Fayal specimens exhibited the usual varietal facies and indicate its abundance on the island. From the Cape, also, there are several characteristic examples.

Section **POMATIA** Beck.

Helix (Pomatia) aspersa Müller.

A few examples (Mus. Nos. 125283, 125287). Fayal.

A widely distributed form; a part of the above quite solid, and elevated.

"From the McRay Firth district to the Channel Isles. Its range extends southward from France to Sicily as well as to Spain, Algeria, and the Azores" (Jeffreys).

Genus **BULIMUS** Scopoli.

Section **COCHLICELLA** Férussac.

45. Bulimus (Cochlicella) ventricosus Draparnaud.

= *B. ventrosus* Férussac.
not *B. ventricosus* Chemnitz.

One specimen, dead (Mus. No. 125281). Fayal.

B. ventricosus occurs in France, the Canary Islands, and also in the Bermudas.

Family STENOGYRIDÆ.

Genus **ACHATINA** Lamarck.

46. Achatina balteata Reeve.

Four specimens (Mus. No. 125307). Free Town, Sierra Leone.

Only one example of the above was an adult. This form, with its fine sculpture, is apparently related to the coarsely sculptured *A. reticulata* Pfr., from Zanzibar and that region, through *A. lactea* Rve., also belonging to the same general locality, and suggesting an intermediate and connecting variety.

47. Achatina variegata Roissy.

= *A. perdix* Lamarck.

Several adult examples (Mus. No. 125377). Free Town.

Subgenus **LIMICOLARIA** Schumacher.

48. Achatina (Limicolaria) flammea Bruguiere.

Three specimens (Mus. No. 125383). Free Town.

49. Achatina (Limicolaria) numidica Reeve.

Two specimens (Mus. No. 125384). Free Town.

Family SUCCINIDÆ.

Genus **SUCCINEA** Draparnaud.

50. Succinea St. Helenæ Lesson.

Several living examples (Mus. No. 125404). Fayal.

The specimens were found on the leaves of plants near the top of Diana's Peak. The shells are of a beautiful deep amber color, and probably belong to the above species. The other form reported from here, *S. bensoni*, was not in the collection.

Superorder STREPTONEURA.

Order CTENOBRANCHIATA.

Suborder ORTHODONTA.

Superfamily TOXOGLOSSA.

Family TEREBRIDÆ.

Genus **TEREBRA** Bruguiere.

51. Terebra strigillata Linné.

A single specimen (Mus. No. 125389). Porto Grande.

52. Terebra senegalensis Lamarck.

One beach shell (Mus. No. 125332). Porto Grande.

53. Terebra chlorata Lamarck.

Several beach specimens (Mus. No. 125354). Porto Grande.

54. Terebra inconstans Hinds.

A single example, beach (Mus. No. 125322). Porto Grande. A widely distributed form.

Family CONIDÆ.

Genus CONUS Linné.

55. Conus guinacus Hwass.

One beach shell, imperfect (Mus. No. 125579). Porto Grande.

Family CANCELLARIIDÆ.

Genus CANCELLARIA Lamarck.

56. Cancellaria similis Sowerby.

One specimen, fair condition (Mus. No. 125344). Porto Grande.

Superfamily RHACHIGLOSSA.

Family OLIVIDÆ.

Genus OLIVA Bruguiere.

57. Oliva flammulata Lamarck.

Two beach shells in fair condition (Mus. No. 125364). Porto Grande.

Genus OLIVANCILLARIA Orbigny.

58. Olivancillaria nana Lamarck.

Several specimens (Mus. No. 125343.) Porto Grande.

Numerous examples of this pretty little shell, generally ornamented with linear, zigzag markings; sometimes not showing these, but unicolored, buff or dark chocolate brown.

Genus AGARONIA Gray.

59. Agaronia acuminata Lamarck.

Two beach shells, Porto Grande (Mus. No. 125581).

Family MITRIDÆ.

Genus MITRA Lamarck.

60. Mitra fusca Swains.

Several examples, Horta, Fayal (Mus. No. 125279).

Many good fresh specimens were obtained here. In Tryon's Monograph of the *Mitridæ*, he says: "*M. adansonii* Phil., described from Gaboon, in Guinea, West Africa, appears to agree fairly with this species."

61. Mitra barbadensis Gmel.

One young perfect specimen, Ascension Island (Mus. No. 125405). Heretofore credited to the Florida Keys and Barbados.

62. **Mitra plumbea** Lamarck.

One example, Porto Grande (Mus. No. 125386). In Tryon's Monograph this is included in the synonymy of *Mitra ebenus*. I should not place it in such a position.

Family FASCIOLARIIDÆ.

Genus **LATIRUS** Montfort.

Subgenus **LEUCOZONIA** Gray.

63. **Leucozonia triserialis** Lamarck.

One beach shell, Porto Grande (Mus. No. 125331).

Family BUCCINIDÆ.

Genus **PISANIA** Gray.

64. **Pisania variegata** Gray.

One adult, beach; two juniors, fresh. Porto Grande (Mus. No. 125580).

Florida Keys, West Indies, Bermuda. Southerly to Trinidad on the American side.

Genus **COMINELLA** Gray.

65. **Cominella limbosa** Lamarck.

= *C. Woldemari* Kiener.

One specimen from each locality. Porto Grande (Mus. No. 125582); Cape Town (Mus. No. 125326).

Family COLUMBELLIDÆ.

Genus **COLUMBELLA** Lamarck.

66. **Columbella rustica** Linné.

Common, fresh, living. Porto Grande (Mus. No. 125316).

The *C. rusticoides* of Heilprin, which ranges on the American shores of the Atlantic from Cedar Keys to Cuba, may be regarded as a synonym of the above.

67. **Columbella rustica** Linné.

variety, *Azorica* Drouét.

Numerous examples. Fayal (Mus. No. 125282).

Subgenus **NITIDELLA** Swainson.

68. **Nitidella cribraria** Lamarck.

Common; Porto Grande.

Upon comparison I can perceive no difference between the foregoing and American examples. This species has a remarkable geographical range. Among the Florida Keys and in the Antillean region, at Panama, on the west coast of South America, northerly to Lower California, and at various places in the Gulf of California.

Family MURICIDÆ.

Subfamily MURICINÆ.

Genus **MUREX** Linné.

Subgenus **PHYLLONOTUS** Swainson.

69. Phyllonotus rosarium Chemnitz.

One beach shell; Porto Grande.

Genus **OCINEBRA** Leach.

70. Murex (Ocinebra) angularis Lamarck.

A single, somewhat dubious example; Porto Grande (Mus. No. 125358).

Subfamily PURPURINÆ.

Genus **PURPURA** Bruguiere.

71. Purpura hæmastoma Linné.

=*P. undata* Lamarck.
=*P. Forbesii* Dunker.

Numerous living and beach examples. Fayal (Mus. No. 125276); Porto Grande (125305, 121370); Ashantee (125310, 125320, 125337); St. Helena (125407).

From Fayal many specimens, some tuberculated, others without knobs. The Porto Grande examples were adults and juniors of the typical form; two of the specimens were quite large, triangular, and knobby. From Ashantee numerous living specimens of the short-spired, rather triangular form, the *undata* of Lamarck and narrower examples =*P. Forbesii* Dunker; others with the spire of the average height, with two rows of knobs more or less conspicuous, varying in this feature as do the west coast American colonies of *biserialis*. A single individual of this widely distributed and mutable form was detected at St. Helena; it is not a characteristic example, having in the white aperture and the inconspicuous transverse ribbing and knobs of the bodywhorl a similar phase of variation from the general aspect of *hæmastoma*, that is exhibited by *P. Blainvillei* Deshayes + *P. Callaoënsis* Blainville of the west coast of South America, when compared with the ordinary facies of *P. biserialis* Blainville of the same coast to the northward. The St. Helena form is very close to a variety of *hæma-*

stoma in the National collection (No. 95953), from Abrolhos Island, coast of Brazil.

72. Purpura cingulata Lamarck.

Two specimens; Cape Town (Mus. No. 125324.)

Only two examples of this remarkably variable and interesting species were obtained; the larger 17.5 millimeters in length, with barely the hint of a keel on the upper part of the basal whorl, which otherwise is finely sculptured with closely set, fine incised lines or grooves, and the upper or apex whorls keeled and cancellated. The small example is only 4 millimeters long, equal to the two and one-half upper whorls of the larger shell. The National collection contains another and somewhat larger specimen of this nearly smooth variety, as well as one individual with a single broad keel upon the upper part of the basal volution, connecting, it will be seen, the plain form with the usual broadly ribbed and channeled typical specimens.

73. Purpura neritoidea Linné.

Three beach specimens. Porto Grande (Mus. No. 125369). These are of the typical knobby form.

Genus SISTRUM Montfort.

74. Sistrum nodulosum C. B. Adams.

One adult, one junior; beach. Porto Grande (Mus. No. 125362).

Common at many places in the Antillean region and on the Florida Keys, etc.

75. Sistrum Brownii nom. prov.

One specimen. Porto Grande (Mus. No. 125357).

Of the same general facies as *S. nodulosum*, but varying in sculptural characters; the National collection contains a similar example from the west coast of Florida.

Suborder STREPTODONTA.

Superfamily PTENOGLOSSA.

Family JANTHINIDÆ.

Genus JANTHINA Lamarck.

76. Janthina rotundata Leach.

=*Janthina communis* Lamarck.

Five examples. Fayal, one specimen (Mus. No. 125297); Porto Grande (Mus. No. 125311), four examples of rather small size, but characteristic.

Superfamily GYMNOGLOSSA.

Family PYRAMIDELLIDÆ.

Genus **PYRAMIDELLA** Lamarck.

77. Pyramidella dolabrata Linné.

Four specimens. Porto Grande (Mus. No. 125349). The above has heretofore been credited to the West Indies, Barbados, the Florida Keys, and west Florida.

Superfamily TÆNIOGLOSSA.

Family TRITONIIDÆ.

Genus **RANELLA** Lamarck.

78. Ranella argus Gmelin.

Two living specimens. Cape Town (Mus. No. 125376). This species also occurs in New Zealand, and has been credited to the west coast of South America.

Family CYPRÆIDÆ.

Genus **CYPRÆA** Lamarck.

79. Cypræa spurca Linné.

Two beach shells. Porto Grande (Mus. No. 125342). Inhabits Antillean and Mediterranean waters.

Family STROMBIDÆ.

Genus **STROMBUS** Linné.

80. Strombus bubonius Lamarck.

=*S. fasciatus* Gmelin.
=*S. coronatus* Defrance.

One living specimen; one fossil Postpliocene example. Porto Grande (Mus. No. 125308).

Family CERITHIIDÆ.

Genus **CERITHIUM** Bruguiere.

81. Cerithium atratum Bruguiere.

One beach specimen. Porto Grande (Mus. No. 125328).

82. Cerithium vulgatum Bruguiere.

=*C. tuberculatum* Linné.

Two beach shells. Porto Grande (Mus. No. 125327.) Common everywhere in the Mediterranean, Adriatic, and Ægean seas, as well

as on the coasts of Spain and Portugal, and the Canaries, from the shore to 50 fathoms. (Jeffreys.)

Family PLANAXIDÆ.

Genus PLANAXIS Lamarck.

83. Planaxis lineatus Da Costa.

Five specimens, living. Porto Grande (Mus. No. 125346).

Occurs in the Viti Islands and at many places in Polynesian waters.

Family VERMETIDÆ.

Genus VERMETUS Mörch.

84. Vermetus Adansonii Daudin.

One large mass and two small examples. Porto Grande (Mus. No. 125306).

The "mass," upon the under side, has been perforated by *Lithodomi*. It includes also some of the following forms.

Genus PETALOCONCHUS Lea.

85. Petaloconchus interliratus nom. prov.

Two masses. Porto Grande (Mus. No. 125378).

The two clumps of *Petaloconchus* above referred to include examples of the preceding species, *V. Adansonii*. While in external facies very like the foregoing, the interior upon close inspection will be found to have an elevated, thread-like ridge following the coiling spirally.

Family LITTORINIDÆ.

Genus LITTORINA Férussac.

86. Littorina striata King.

Many specimens; living. Fayal at Horta (Mus. No. 125296), Porto Grande (Mus. No. 125363).

87. Littorina pulchella Dunker.

Numerous examples, fresh. Ashantee (Mus. No. 125338). Porto Grande (Mus. No. 125325).

Several specimens of this rather globose and somewhat angulated form were obtained; it resembles some of the West Mexican species.

88. Littorina scabra Linné.

var. *lineata* Gmelin.

Common, living. Ashantee (Mus. No. 125336). Numerous living examples of this well-known species were found "sticking to bushes,

at the mouth of the Etry river." The specimens are of the variety *lineata* Gmelin and agree perfectly with Indo-Pacific examples, of which first and last I have handled a great number. One variety of the large Antillean-Floridian *L. angulifera* Lamarck, brown-colored, approaches closely to the ordinary aspect of *scabra*, but I have never met with examples of the Indo-Pacific *scabra* that exhibited the light pink and yellow or varied color aspects of the Antillean form, nor have I observed in the large quantity of the Antillean-Floridian forms collected and otherwise examined, certain varietal features that are exhibited by the Polynesian *scabra*.

89. Littorina cingulifera Dunker.

One example fresh. No locality, probably Cape Town (Mus. No. 125394).

Genus **TECTARIUS** Valenciennes.

90. Tectarius miliaris Q. and G.

=*T. echinata* Anton.

One specimen; Ascension Island (Mus. No. 125420).

Family FOSSARIDÆ.

Genus **FOSSARUS** Philippi.

91. Fossarus ambiguus Linné.

Many examples; Porto Grande (Mus. No. 125371).

Several specimens of both the coarsely ribbed and finely striate forms of this little shell were in the Eclipse collection. They were found attached to other shells and in the crevices of masses of *Vermetus*, etc.

Family AMPULLARIIDÆ.

Genus **AMPULLARIA** Lamarck.

Subgenus **LANISTES** Montfort.

92. Lanistes ovum Peters.

Numerous specimens, Cunga, Dec. 25, 1889; (Mus. No. 125585).

Abundant in a pond near Cunga.

Family CALYPTRÆIDÆ.

Genus **TROCHATELLA** Lesson.

93. Trochatella radians Lamarck.

=*Trochita radians*, Lamarck, Auct.
=*Infundibulum radians*, Orbigny.
=*Infundibulum radians*, Montfort, Tryon.

One, beach shell. Porto Grande (Mus. No. 125312).

The above example, though imperfect, is in a sufficiently good condition, and of sufficient size as to leave no doubt as to the determination. It measures maximum 4.25, minimum diameter 29 millimeters.

It has not before been reported outside of Peru and Chile.

Family AMALTHEIDÆ.

Genus **AMALTHEA** Schumacher.

94. **Amalthea barbata** Sowerby.

= *Hipponyx barbatus* Sowerby.

A single specimen. Porto Grande (Mus. No. 125390).

Not before reported away from the west coast of the Americas.

Family NATICIDÆ.

Genus **NATICA** Lamarck.

95. **Natica porata** Reeve.

One specimen. Fayal (Mus. No. 125291).

Superfamily DOCOGLOSSA.

Family PATELLIDÆ.

Genus **Patella** Linné.

96. **Patella rustica** Linné.

Common. Fayal (Mus. No. 125277).

A good series of this species of various sizes, points to the two following of Drouët's, as probable synonyms.

97. **Patella Moreleti** Drouët.

Example. Fayal (Mus. No 125299).

This species is probably nothing more than a variety and junior of *P. rustica* Linné.

98. **Patella Gomesii** Drouét.

One specimen, beach. Fayal (Mus. No. 125290).

The above example though a beach shell is in tolerable condition; it agrees with Drouét's figure and description. *P. Gomesii* suggests a variety of the Linnean species *rustica*.

99. **Patella Argenvillii** Krauss.

Numerous examples. Island of Saint Helena (Mus. No. 125412); Cape Town.

Several fine living specimens of this limpet were detected at St. Helena. It has somewhat the appearance of *P. granularis*, but the

close-set radiating costæ characteristic of both species, are not broken up into granules. The two Cape Town shells are large adult examples and well represent this characteristic species.

100. Patella plumbea Lamarck.

= *P. plicata* Born.
= *P. lugubris* Reeve (Fig. 32)

One example; Porto Grande (Mus. No. 125353).

Born's species seems to be simply a strongly sculptured variety of *plumbea*, and Reeve's *lugubris* from the island of St. Vincent, I regard as another varietal aspect of the Lamarckian species.

101. Patella pruinosa Krauss.

One beach shell, imperfect; Cape Town (Mus. No. 125370).

102. Patella granularis Linné.

= *P. denticulata*, Martin.

Many examples living; Cape Town (Mus. No. 125396).

Numerous specimens, both mature and adolescent.

103. Patella Baudonii Drouét.

Several specimens; Cape Town (Mus. No. 125375).

Described by Drouét from the Azores. The examples collected by Mr. Brown indicate a close relationship to *P. Argenvillei* and may ultimately prove to be only a varietal form of said species.

104. Patella occulus Born.

Three specimens; two juniors, in alcohol; Cape Town.

A strongly characterized species.

105. Patella cochlear Gmelin.

One specimen, alcohol; Cape Town.

Superfamily RHIPIDOGLOSSA.

Family PHASIANELLIDÆ.

Genus PHASIANELLA Lamarck.

106. Phasianella capensis Dunker.

Two good specimens; Porto Grande (Mus. No. 125302).

107. Phasianella pulla Linné.

Two examples in good condition; Porto Grande (Mus. No. 125304).

108. Phasianella neritina Dunker.

Three specimens; Cape Town (Mus. No. 125382) a pretty well-marked species.

Family TROCHIDÆ.

Genus MONODONTA Lamarck.

Section OSILINUS Philippi.

109. Osilinus Tamsi Dunker

?=*O. Saulcyi* W. & B.
?+*M. punctulata* Lamarck.

Common living; Porto Grande (Mus. No. 125586).

Variable in umbilical character and otherwise; sometimes elevated, conical, and again frequently depressed; often exhibiting two or three obtusely rounded ribs following the periphery spirally, with a shallow groove between. Some examples are closely spirally lirate, and others are without liræ. Specimens are frequently met with that are obtusely angulated. Some individuals are ornamented with light zigzag markings, others have only a few distant light spots on a dark ground; these point intimately toward *punctulata*. Apex when eroded, yellowish.

Section OXYSTELE Philippi.

110. Oxystele sagittifera Lamarck.

Three living specimens; Cape Town (Mus. No. 125373.)

Genus GIBBULA Risso.

111. Gibbula nassaviensis Chemnitz.

?=*Gibbula umbilicatus* Montagu, variety.

Three specimens; Porto Grande (Mus. No. 125359).

The three shells of the foregoing species, collected as above, are in good condition. In the National collection under the same name I find numerous examples that were identified by the late Dr. Stimpson (Mus. No. 18686). Upon turning to the author I find his description altogether too brief, and the figures too indefinite to make a satisfactory determination thereby. Neither upon following his name through the synonymy is a satisfactory result obtainable as to the identity of the shell he has named. The umbilical character is of no value whatever in this instance, for some individuals are distinctly umbilicated, others are not, and again others are partially perforated. The shells, considered apart from the confusion of names and conjectures as to the meaning of authors, appear to be an extra limital and dwarfed aspect of *umbilicaris* Linné=*T. umbilicatus* Montagu.

Philippi makes *nassaviensis* a synonym of his *occulta;* and A. Adams includes *nassaviensis* preceded by a ? in the synonymy of *Gibbula*

tumidus of Montagu. The National Museum series contains specimens from the Cape of Good Hope (No. 43098).

Family TURBINIDÆ.

Genus ASTRALIUM Link.

112. Astralium tuber Linné.

One specimen; no locality given; probably Barbados.

Occurs in Florida, at Jupiter Inlet and the Keys, as well as at numerous places in the Antillean region.

Family NERITIDÆ.

Genus NERITA Bruguiere.

113. Nerita neritinoides Reeve.

Numerous specimens, living; Ashantee (Mus. No. 125319).

The foregoing appears to be quite an abundant form. Sowerby's *morio* and Philippi's *carbonaria* are apparently the same.

114. Nerita ascensionis Chemnitz.

Common; many examples, living; Ascension Island (Mus. No. 125401).

A pretty shell, apparently abundant.

Superfamily ZYGOBRANCHIA.

Family HALIOTIDÆ.

Genus HALIOTIS Linné.

115. Haliotis striata Lamarck.

One good specimen. Fayal (Mus. No. 125280).

Family FISSURELLIDÆ.

Genus FISSURELLA Bruguiere.

116. Fissurella alabastritis Reeve.

+ *F. glaucops* Reeve.

Three beach shells. Porto Grande (Mus. No. 125392).

117. Fissurella mutabilis Sowerby

Two living specimens. Cape Town (Mus. No. 125372).

The above agree perfectly with named examples received from the Albany Museum.

Subclass ISOPLEURA.

Order POLYPLACOPHORA.

Family LEPTOCHITONIDÆ.

Genus Leptochiton Gray.

118. Leptochiton cyaneopunctatus Krauss.

? = *lentiginosus* Sby.

One specimen. Cape Town (Mus. No. 125380). A single small example, so close to Krauss's figure and description that I attach his name to it, though the color varies somewhat from his diagnosis. It also exhibits some of the characters of Gray's *C. capensis*.

Family ISCHNOCHITONIDÆ.

Genus **Lepidopleurus** Risso.

119. Lepidopleurus purpurascens C. B. Adams.

Barbados.

Class CEPHALOPODA.

Order DIBRANCHIATA.

Suborder OCTOPODA.

Family OCTOPODIDÆ.

Genus **OCTOPUS** Lamarck.

120. Octopus ? vulgaris Lamarck.

One specimen, alcohol. Ascension Island, March 25, 1890; dredged 20 to 30 fathoms.

Suborder SEPIOPHORA.

Family SEPIIDÆ.

Genus **SEPIA** Lamarck.

121. Sepia officinalis Linné.

One fine example. St. Paul de Loanda (Mus. No. 117941; in alcohol).

Suborder PHRAGMOPHORA.

Family SPIRULIDÆ.

Genus **SPIRULA** Lamarck.

122. Spirula fragilis Lamarck.

Fayal (Mus. No. 125292). Beach specimens; a widely distributed form; pelagic.

SUMMARY.

Pelecypods		35
Gastropods, marine	69	
Gastropods, land	13	
	—	82
Cephalopods		5
		—
Total number of species		122

ON RARE OR LITTLE KNOWN MOLLUSKS FROM THE WEST COAST OF NORTH AND SOUTH AMERICA, WITH DESCRIPTIONS OF NEW SPECIES.

BY

ROBERT E. C. STEARNS, Ph. D.

Adjunct Curator of the Department of Mollusks.

(With Plate L.)

The forms included in this paper are all in the collection of the U. S. National Museum. Eight of the fourteen were collected by Mr. W. J. Fisher in the Gulf of California region several years ago. The others were collected by various persons: Dr. W. H. Jones, U. S. Navy; Dr. Edward Palmer, Capt. George D. Porter, and others. A part of the species have already been described. In some cases these descriptions required revision and information relating to the species not before available has been added.

The number of forms heretofore associated in the monographs and by the principal authors with an Indo-Pacific habitat will attract attention. A comparison of the marine portion of the mollusk fauna of the Gulf region, with that of the Galapagos, as exhibited in the collection made by the U. S. Fish Commission steamer *Albatross*, a catalogue of which is nearly ready for publication, gives a much larger representation of distinctly Indo-Pacific or Polynesian species to the former. In connection with the Polynesian species, attention is called to the beautiful embroidered cone described by me in 1873,* *Conus Dalli*, in its general aspect, color, markings, etc., approaching very closely to some of the species in the group represented by *C. textile*. The original examples were obtained by vessels in the Gulf trade and brought to San Francisco. Subsequently, in 1876, Mr. Fisher collected numerous specimens, living and beach shells, at the island of Maria Madre, of the Tres Marias Group, in the mouth of the Gulf, and I have since seen several adolescent examples from the Gulf region, which sustain the validity of the species and indicate that it is found not infrequently within the Gulf area or upon its shores.

Family APLYSIIDÆ.

Genus DOLABELLA Lamarck.

Dolabella californica Stearns.

Proc. Acad. Nat. Sciences, Philadelphia, 1878, p. 395, Pl. VII, Figs. 1, 2.

Several examples (Mus. No. 75001), Mulege Bay, Gulf of California. This form was first detected by Mr. W. J. Fisher in 1876. I have

* Proc. Cal. Acad. Sciences, April 7, 1873, Pl. I, Fig. 1.

not heard of its being collected since. In Mr. Fisher's notes he says that the Aplysia-like animal prefers "dark places in pools left by the tide."

The shell is internal, triangular, hatchet-shaped, with a curved and callous nucleus or apex; entire shell hard and calcareous *when adult;* when young more or less membranaceous and flexible. Though several examples of the above, soft parts and all, were obtained, I was unable to get an entire specimen for investigation. Mr. Fisher, who made no drawings at the time of collecting, informed me that the animal was of the same general form that authors have given of Aplysia,* the color of the Fisher individuals being a dark brown and the surface covered with wartlike papillæ. In the matter of the color this species probably varies as do individuals of the others.

The various forms heretofore described are principally inhabitants of the Indo-Pacific province, and the Mediterranean region is also credited with a representative of this group.

The shell of *D. californica* is in outline very much like that of *D. Rumphii* Cuvier=*D. scapula*, Martyn.

The nuclear callosity varies more or less in different specimens.

Family ONCHIDIDÆ.

Genus **ONCHIDELLA** Gray.

Onchidella Binneyi Stearns.

Plate L, Figs. 1, 2.

=*Onchidella Carpenteri* Binney, Stearns, Proc. Acad. Nat. Sciences Phila., 1878, Pl. VIII, Figs. 7, 8.

=*Onchidella Carpenteri* Binney. Third supplement to vol. V, air-breathing mollusks of the U. S., vol. XIX, Bull. Mus. Comp. Zoölogy, Cambridge, Pl. VI, Figs. D and E, p. 214.

not *Onchidium Carpenteri* Binney. Proc. Ac. Nat. Sc. Phila., 1860, 154; L. & F. W. Sh. of N. A., i, 307–308, Fig. 544 (1868) nor

Onchidella Carpenteri Binney, Manual Am. Land Shells, Bulletin 28, U. S. Nat. Mus., 1885, p. 163, Fig. 150.

Oncidiella? Carpenteri W. G. Binney, Fischer and Crosse. Mission Scientifique au Mexique et dans l'Amérique Central.

Several examples (Mus. No. 58824). San Francisquita Bay, Los Animas Bay, and Angeles Bay in the Gulf of California.

The form listed herein was collected by Mr. W. J. Fisher at the places indicated; all of the specimens were living. A description with figures was published by me in the Proceedings of the Philadelphia Academy in 1878. Mr. Binney's *Onchidium Carpenteri* was the only form of the family that had been credited to the Gulf region; without looking into the matter sufficiently, I assumed that Mr. Fisher's specimens belonged to Mr. Binney's species.

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* See Woodward's Manual, 2d ed., p. 321.

The figures recently given by Mr. Binney in his third supplement to the fifth volume of the Air-Breathing Mollusks of the United States are not new drawings from the original specimens which furnished a basis for the brief and partial description of *O. Carpenteri*, as first published by him in the Proc. Acad. Nat. Sciences of Philadelphia, but from a specimen sent to him by Mr. Dall, one of the Fisher lot described by me in 1878, and, as I now regard it, erroneously referred to his species. His *O. Carpenteri* is a much smaller form, "the length of the largest* being 5 millimeters, the extreme breadth 3 millimeters," while the Fisher specimens average 17.2 in length by 12.2 millimeters in breadth.

My former description is here given with some modifications. Body oblong ovate, about a third longer than wide; convex or rounded above, flat on the under side; anterior and posterior ends equally rounded; dorsum formed by the mantle and entirely covering the back, which is of a smoky-brown color, coriaceous and quite thick at the edges; under side of a dingy, yellowish color. Surface of dorsum covered with wartlike papillæ, some larger than others, the larger having somewhat the aspect of regularity, the interspaces being filled with the smaller; creeping disk or belly, elongated, nearly as long as the animal, and its width equal to about one-third of the entire width as seen from the under side.

Sexual organs on the right side, near the head. Respiratory orifice on the left side, between the edge of the creeping disk and the mantle, at a point about two-fifths of the total length from the posterior end. Anal outlet on the right side, very near the posterior extremity of and just above the edge of the creeping disk. The eye peduncles rather short, and these as well as the buccal appendages are obscured by the contraction caused by the alcohol. The creeping disk being comparatively soft is much contracted by the same cause. Mr. Fisher remarked that he found this form "abundant, attached to the under side of stones at low tide, sometimes overlapping each other."

In Hutton's Catalogue of the Marine Mollusca of New Zealand, he includes a species, *Onchidella nigricans* Quoy, "uniform black, * * * common on rocks between tide marks," having the same habit in this respect as *O. Binneyi*.

The localities where Mr. Fisher collected his specimens are in the Gulf of California, on the westerly shore, the first in latitude 28° 26′, the second in 28° 50′, and the third and last in latitude 29 north, as it will be observed, not far from each other. *Onchidium Carpenteri* Binney is credited by the author as ranging geographically from the "Strait of Fuca to the Gulf of California." It is probably a distinct species and will sooner or later be verified by additional specimens in a suitable condition to admit of its characters being definitely ascertained and described.

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* Binney's Manual, p. 163.

Family FASCIOLARIIDÆ.

Subfamily FUSINÆ.

Genus **FUSUS** Lamarck.

Fusus? polygonoides Lamarck.

A single example, agreeing more closely with this species than any other that is contained in the National collection or that has been described or figured, was collected at Catalina Island, California, by Mr. Fisher (Mus. No. 32348).

Family NASSIDÆ.

Genus **NASSA** Lamarck.

Nassa brunneostoma Stearns.

Described in "Nautilus," May, 1893, Vol. VII, pp. 10–11.

Shell small, elongated ovate, of seven to eight whorls, with a pointed and acutely elevated spire with generally three spiral series of granules; occasional individuals show four series on the penultimate whorl and six to seven on the basal. In some examples the sculpture has the appearance of longitudinal ribs broken up into granules; in others the sculpture suggests spiral or revolving ridges broken into granules; in some examples the granulation covers nearly the whole of the basal whorl; in others an area equal to the last third of the basal whorl is comparatively smooth. In some individuals the granules next below the suture are more conspicuous than the others, and again a double row of more prominent granules are seen on the upper part of the basal whorl. In some individuals the suture is distinct, in others obscure. Most of the examples exhibit fine revolving liræ on the lower half of the basal whorl.

The aperture is small, ovate, about one-third the length of the shell; the outer lip is thickly rimmed externally and usually crenulated and denticulate within just below the edge. Columella roundly arcuated with the usual callus above and a single terminal plication at the base of the pillar, with four or five obtuse ridges above. The greater part of the basal whorl, as seen in front, is covered with shiny callus of a warm chestnut brown, varying more or less in depth of color, in some cases quite light. When held up to the light, on looking through the aperture, an obscure lightish band is perceptible. The warm brown glaze surrounding the aperture and covering the pillar is quite characteristic, and together with the acute and elevated spire, makes it easily separable from its nearest congeners. Its nearest relatives geographically and otherwise are *Nassa complanata* Powis (=*N. scabriuscula* C. B. Ad.) and *N. tegula* Reeve (=*N. tiarula* Kiener), both common in the Gulf region and forming, with *brunneostoma*, a little group exhibit-

ing similar general characters. Some examples of *brunneostoma* are more robust than others and vary in the elevation of the spire.

Dimensions: Length of largest, 16 millimeters; breadth, 9 millimeters; an intermediate example measures 15 millimeters in length and 8 millimeters in breadth. This last is, however, much above the average in size.

HABITAT.—Gulf of California, near the mouth of the Colorado River (Mus. No. 37239); also at Guaymas, on the easterly shore (No. 23721, 55951), where numerous examples were collected by Dr. Edward Palmer.

Family MURICIDÆ.

Subfamily MURICINÆ.

Genus **MUREX** Linné.

Subgenus **CHICOREUS** Montfort.

Chicoreus palma-rosæ Mexicana Stearns.

= *palma-rosæ* Lamarck, var?
? = *M. affinis* Reeve.
? = *M. Steeriæ* Reeve.

A single example (Mus. No. 46803), in fair condition.

The occurrence on the west coast of any form allied to the palma-rosæ group of Murices has not heretofore been reported. In several instances during my residence in California I noticed worn beach shells of the above in material received from the Gulf of California. The specimens were usually in such poor condition as to be of no value as examples for the cabinet, and the geographical fact of their appearance among west-coast shells did not impress me sufficiently, until Mr. Fisher returned from his Gulf expedition with the quite fair specimen herein listed. It hardly agrees with either of the described forms above referred to, neither does it differ greatly. A comparison with the monographs is not quite satisfactory, and the various examples in the National Museum of such forms as it most nearly approaches, are not sufficiently numerous to remove the doubt. I have given it the above name, as in other instances in this paper, solely for the object that the geographical fact may be clinched and made known. It may ultimately prove to be a variety of Reeve's *affinis*, for which he has given no habitat.

The allies of the form known as *palma-rosæ* include the following: *M. palma-rosæ* Lamarck, *M. Steeriæ* Reeve, *M. Sauliæ* Sowerby, *M. maurus* Broderip, and *M. affinis* Reeve.

The salient features of the group are well illustrated in the principal and best known form, the species first named.

The character, number, and arrangement of the fronds upon the varices or varical fronds are quite persistent in all of these species, and they all have minor characteristics in common.

Commencing with the upper part of the varices, is the principal frond and this is divided or bifid, or we may say it is composed of two fronds uniting and forming one, the main frond; then comes a gap, followed by three fronds, then another gap followed by two fronds, and this system of one, three, and two is exhibited usually in each of the three varices of the body whorl.

Chicoreus Leeanus Dall.

Proc. U. S. Nat. Museum, vol. XII., pp. 329–330, 1889.

Two examples of this rare and striking species were brought to my attention when in San Diego, in May, 1892, by Miss J. N. Cooke. The larger measured 90, the smaller 75 millimeters in length. They were both collected by Capt. G. D. Porter. The first was found living between tide marks in sand, one in San Ignacio lagoon, Lower California; the other was a beach shell. Dall's type was dredged off Cerros Island, Lower California, in 44 fathoms muddy bottom by the U. S. Fish Commission steamer *Albatross*, in 1888. It measured 70 millimeters.

Genus **OCINEBRA** Leach.

Ocinebra lugubris Sby.

Murex lugubris Sby. Proc. Zoöl. Soc. London, 1832, p. 175. Conch. Illus., Fig. 26. Reeve, Iconica, Sp., 143.
Murex erinaceoides Valenciennes. Recueil d'observations, etc., ii, 302, 1833.
Murex californicus Hinds. Proc. Zoöl. Soc. London, 1843, p. 128. Voyage Sulphur, t. 3, pp. 9, 10.
Murex californicus Reeve. Conch. Iconica, Sp., 144.
Murex (*Ocinebra*) *erinaceoides* Val. (= ? *M. californicus* Hinds) Stearns. Proc. Acad. Nat. Sciences, Phila., 1878, pp. 395, 396.

Collected by Mr. W. J. Fisher at La Paz, Lower California, in 1867 (Mus. No. 46767).

In the late Dr. Carpenter's reports to the British association (1856 and 1863) reference is made to *Muricidea erinaceoides* by name only.

In his Mazatlan catalogue, however, he has described a "var. *indentata*," of a form which he presumes to be Valenciennes's species, and suggests a comparison with Kiener's *Murex alveatus*. In the Smithsonian check-list, June, 1860, he included Kiener's name, but omitted that of Valenciennes. The "*alveatus*" of Kiener is a quite distinct form, not at all like *lugubris*.

The form under review came to my notice many years ago and its determination sorely puzzled others as well as myself. About the same times numerous examples of the European *M. erinaceus* were received from various sources and from several localities, from the British Coast to the Mediterranean shores of southern Europe. The close resemblance of the West American to certain examples of the European form at once attracted my attention and placed me on the right track to identification.

The propriety of Valenciennes's name was evident from the material

examined at the time and has since been shown, as further specimens have come to hand from other localities on the coast of Lower California

Hinds described the shell as having six varices, but his figures show only three. Reeve's description is correct in mentioning three varices alternating with nodes or ribs. I think that Hinds unintentionally included the three internodes as varices in his description.

The variation exhibited by *lugubris* is so great that it may ultimately be connected with *trialatus*; the type of *lugubris* as figured is hardly characteristic when the general facies of a large number of examples is considered. It is to be regretted that the more appropriate name of Valenciennes has to give way to that of Broderip.

Subfamily PURPURINÆ.

Genus **PURPURA** Bruguiere.

Purpura hippocastanum Linné.

A single living example of this Polynesian species, occurring in the Viti, Samoan, and Pelew islands, as well as in the Australian region, was detected at Mulege Bay, on the eastern shore, Gulf side of the peninsula of Lower California.

Family TRITONIIDÆ.

Genus **RANELLA** Lamarck.

Ranella cruentata Sby.

This form, generally regarded as Indo-Pacific or Polynesian, collected at the Viti Islands by the late Andrew Garrett, was dredged by the *Albatross* (depth 31 fathoms, rocky bottom) off Lower California in latitude 22° 52′, longitude 109° 55′. This is near Cape St. Lucas, the extremity of the peninsula. This adds another Indo-Pacific form to the many instances noticed in the Fisher collection, and may be explained perhaps by the great depth of water that prevails so close to the coast, and curves well up into the Gulf of California, where the 1,500, fathom line reaches a point that would be intersected or touched by a line drawn across the Gulf from Cape St. Lucas to Mazatlan and reaches nearly up to the Tres Marias Islands on the south. In fact the depths of 1,724 to 2,395 fathoms were found between the end of the peninsula and Corrientes.* (Mus. No. 125665.)

The remarkable distribution of this species is still further corroborated by an example collected by Mr. Charles T. Simpson, of the U. S. National Museum, who detected it at the island of Utilla, on the coast of Honduras.

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* *Albatross* Explorations, A. Agassiz in Bull. Mus. Comp. Zoöl., Vol. XXIII, No. 1.

Family CASSIDIDÆ.

Genus **CASSIS** Lamarck.

Subgenus **CASMARIA** H. and A. Ad.

Casmaria vibex Linné.

An example of this form (Mus. No. 88831) was detected on the beach at the island of Maria Madre, of the Tres Marias, by Mr. Fisher. It is a crab shell with the columella considerably excavated by its alien tenant; the extreme upper or apex whorls are wanting; otherwise the specimen is in good condition, the surface polish and the color being intact, with a hint of the broad obscure color bands sometimes seen in this species, and the fine dots or minute color spots that occur along the line of the bands where they are intersected by lines of growth. Though a small specimen, only 33 millimeters long by 21.5 millimeters in breadth, it is solid and mature, with a thick callus in the columella region and a heavy rim to the outer lip, exteriorly broadened and prettily color-marked, as frequently seen in this species. This example is inconspicuously obtusely noduse on the upper part of the basal whorl, which is also slightly angulated below the suture. The lower part of the outer lip, though somewhat worn, shows faint crenulation.

Another example of this species, the smooth, thin, inflated form, was collected at La Paz, on the opposite side of the Gulf, near the southern extremity of Lower California, by Mr. L. Belding. This has a thin or only slightly thickened rim to the outer lip; the color markings or spots on the same are inconspicuous, the deposit of callus in the columella region is slight, and the subsutural nodes of the basal whorl are barely perceptible. This also is a crab shell, the pillar very much worn away and the tip of the apex is broken or worn off; the surface of the shell is in good condition and still exhibits its normal gloss. The Belding specimen is considerably larger than the Fisher shell, and measures lon. 44.25, lat. 24.50 millimeters (Mus. No. 34184).

Family CYPRÆIDÆ.

Genus **CYPRÆA** Linné.

Subgenus **LUPONIA** Gray.

Luponia isabella—mexicana Stearns.

Plate L, Figs. 3, 4.

=*C. controversa* Gray, Stearns, Proc. Phila. Acad. Nat. Sciences, Phila. 1878, p. 399.

In Sowerby's monograph of *Cypræa* in the Conchological Illustrations, species 30, Fig. 136, no habitat stated, reference is made to

what at that time (1878) I regarded as probably applying to this West Coast form. The only comment in Sowerby's text is "30—*C. controversa, Gray*, Zoöl. Jour., t. 7 and 12, p. 7. Obs. This may prove to be only a variety of *C. isabella*."

My remarks in the Proc. of the Phila. Academy, following the above quotation from Sowerby, with the West Mexican examples before me, were as follows:

While its general coloration would lead to its being grouped with *C. isabella* of the Indo-Pacific and *C. lurida* of the Mediterranean regions, it differs more from the former than from the latter species. While it is a more ventricose form than *C. isabella*, in this respect being nearer to *C. lurida*, the edges of the lips are not as finely and closely crenulated as in *isabella* nor as coarsely as in *lurida*.

Numerous examples, some fresh and living, others beach shells, were collected by Mr. Fisher at the Maria Madre and San Juanita islands of the Tres Maries group.

The figure of *controversa*, in Sowerby, represents a more globose form than any example of *isabella* that I had seen at the time of my examination of the Fisher shells, and these latter, as a whole, varied in this character from any examples of *isabella* I had met with, and agreed more nearly with Sowerby's figure. Since then I have seen numerous specimens of rather short or ventricose *isabellas*, notably a lot kindly sent to the Museum by Mr. Isaiah Greegor, of Jacksonville, Fla. An example (No. 23394) from the "Gulf of California," collected by Capt. Pedersen, has somewhat more of the ordinary aspect of the Indo-Pacific *isabellas*. The Pedersen shell is too much worn to be of service in the matter of determining the color. The Museum also contains examples collected by Dr. Edward Palmer, credited to "Cape St. Lucas" (No. 23685). Of the fresh examples collected by Fisher, the figure represents the largest, highest colored, and most strongly characterized individual; the ground color is nearly as dark as the average of *lurida* (certainly as dark as a light-colored lurida); the dark, longitudinal, irregular linear markings sometimes, rather rarely, met with in specimens of *isabella*, are exceedingly conspicuous, and the blotch-like spots at the apical and opposite extremity strongly exhibited; these are dull orange, shaded down with reddish brown. It may be that this is an extreme example; by itself it might well be regarded as a distinct species; this fine shell, as well as others in the Fisher lot, presents, in a greater or less degree, a combination of the characteristics of both *isabella* and *lurida*.

The individual figured has the following dimensions: Length, 39 millimeters; diameter, 22 millemeters. (Mus. No. 46581.)

The National collection contains 1 example (beach), No. 23394, "Gulf of California," collected by Capt. Pedersen; 10 from the "Tres Marias," Nos. 46581 and 46582, Fisher; 7 from "Cape St. Lucas," Nos. 23685, 55861, 55862, Dr. Edward Palmer; and 46580, 1 example "Gulf of California."

Family LITTORINIDÆ.

Genus **TECTARIUS** Valenciennes.

Tectarius atyphus Stearns.

Pl. L, Fig. 5.

Preliminary description, "Nautilus," December, 1892.

Shell small, ovate, subturreted, with five whorls; the basal traversed spirally by five principal obtuse keels, or ribs, broken into nodules; of these the peripheral keels are the strongest; between these and below the lower of the stronger keels, fainter keels or striæ are perceptible; the penultimate whorl shows three rows of nodules; of these the two upper are the more prominent and the lower one is sutural and inconspicuous. Color, dull ashen chocolate above, lighter below the periphery of the basal whorl, and mottled below the lowest keel. Aperture rather ovate than round, dark colored within; columella somewhat excavated and of a pale chocolate tint. Near the base of columella the hint of a lightish band may be seen, from the edge of the outer lip, inward.

Dimensions: Alt., 6.25; lat., 4 millimeters.

A single example (Mus. No. 48396), from Manta, Ecuador, collected by Dr. W. H. Jones, U. S. Navy.

This is the first example of this group of the Littorinidæ detected on the west coast of the American continents. It is rather remarkable, when the abundance of *Tectarius muricatus* and its ally, *Echinella nodulosa* in the Antillean-Caribbean region is considered.

Many of the so-called species of *Littorina* inhabiting the Caribbean and Panamic waters or shores are so much alike as to at once suggest a common ancestry within comparatively recent geological times. The species described above is quite distinct from *T. muricatus* or *E. nodulosa*, and exhibits in the details of its characters such differences as to warrant specific designation.*

Family TURBINIDÆ.

Genus **ASTRALIUM** Link.

Subgenus **UVANILLA** Gray.

Uvanilla regina Stearns.

Pl. L, Figs. 6, 7.

Preliminary description, "Nautilus," 1892.

Shell conic, acute, imperforate, black or purplish black; whorls six or seven, concave and longitudinally somewhat obliquely corrugated or plicated, the plications more or less produced or overlapping at the suture and periphery or edge of the basal whorl, producing a closely crenulated or undulating effect just above the suture, and at the basal

* Vide Proc. U. S. National Museum, Vol. XIV, p. 326.

edge; surface otherwise closely sculptured by incremental striæ, which run at right angles to and cross the longitudinal plicæ. Base concave, radiately closely lamellose plicate; plicæ sharply defined and becoming more prominent as they approach the periphery, flattening, coalescing and sinuously curving at the edge, which latter is followed by a shallow sulcation or groove parallel to and just back thereof; this groove commences at the point where the upper edge of the outer lip joins the basal whorl and extends towards the lower edge of the aperture, where it is less distinct. Aperture obliquely subangulate; outer edge black, thin, crenulated, nacreous, silvery white toward the edge, bright lustrous golden-yellow within and around the umbilical region, which latter, though deeply excavated, is not open. Columella white, calloused, arcuated, with a moderately conspicuous rounded rib bounding the umbilical depression, and terminating in a single tubercle. A shallow furrow then follows the inner rib, terminating in a notch just below the tubercle, and the umbilical region is still further characterized by an exterior or outer rib, part of the way double, of a brilliant orange, which color blends in, more or less, along the edges of the rib, to the bright yellow around it. A shallow furrow follows along the course of this outer rib also, becoming obsolete toward the aperture. The base of the shell is further sculptured, rather obscurely, by faint revolving lines.

Dimensions: Altitude, 36.0; diameter, maximum, 34.0 millimeters.

The above species combines the sculptural features of the Japanese *Chlorostomas* and the West American *Uvanillas*, more especially *U. olivacea*. It is a much handsomer shell than the latter, and geographically the most northerly species of the group thus far detected on the west coast. It is numbered in the register of the department 125314.

Family TROCHIDÆ.

Genus CHLOROSTOMA Swainson.

Chlorostoma gallina, var. multifilosa Stearns.

Pl. L, Figs. 8, 9.

Preliminary description, "Nautilus," December, 1892.

Shell imperforate, large, heavy, solid, thick, turbinate, elevated, inflated, globosely conical, with five and one-half to six and one-half whorls; whorls rounded; suture simple, moderately distinct, not channeled; apex obtusely pointed, eroded, and yellowish at the tip; color nearly black when wet, reddish or purplish black, when dry; sculpture spiral, consisting of numerous narrow, closely set, rounded ridges or costæ, separated by narrower incised whitish thread-like grooves; aperture rounded, oblique, subangulate on the columellar side and pearly within; outer edge black-rimmed, finely crenulated and mottled by the projection of the lighter colored groovings; columella short,

arcuated, with two somewhat elongated tubercles near the base, and a shallow umbilical pit above; base convex.

Altitude 36; diameter, maximum, 34 millimeters.

HABITAT.—Guadalupe Island, "among the rocks," Capt. George D. Porter. This island is off the outer coast of Lower California, in latitude 29° north and longitude 118° west; it belongs to Mexico. (Mus. No. 125315.)

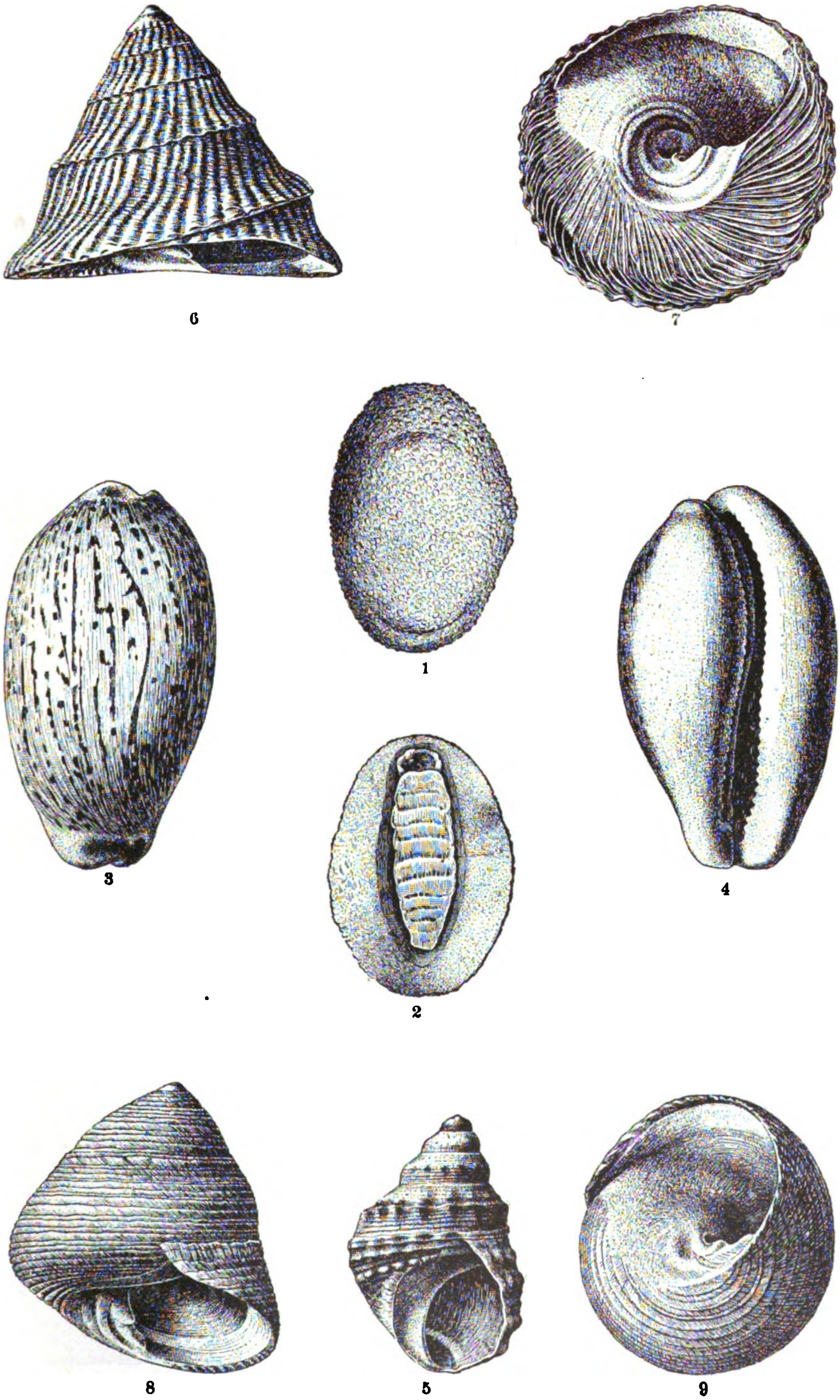
The ridges are not of equal thickness, but vary considerably; in some instances twice as thick or wide as in others; and both ribs and grooves are somewhat coarser on the base than elsewhere. The example before me varies from the ordinary aspect or typical form of Forbes's *gallina*, by the *absence throughout of any trace of "longitudinal markings or sculpture*," and from Hemphill's var. *tincta* in the *absence* of the "streak of yellow on the base, just below the columellar teeth;" in the latter also "the longitudinal markings and sculpture are obsolete, and the spiral grooves generally scarcely visible above," while in the example herein described the entire surface is *conspicuously ribbed and grooved throughout.*

The exceeding variability exhibited by *gallina* and the related forms of this genus on the west coast is such that I do nct feel warranted in regarding this fine and strongly characterized shell as a new species; it can, however, with propriety, be assigned, and is well entitled to an easily recognized varietal position.

EXPLANATION OF PLATE L.

NOTE.—The figures following the authority for the specific name denote the actual size in millimeters of the specimen figured.

Fig. 1. *Onchidella Binneyi* Stearns, dorsal view, 17.2 × 12.2.
2. *Onchidella Binneyi* Stearns, ventral view.
3. *Cypræa isabella-mexicana* Stearns, 39.0 × 22.
4. *Cypræa isabella-mexicana* Stearns.
5. *Tectarius atyphus* Stearns, 6.25 × 4.0.
6. *Uranilla regina* Stearns, 36.0 alt.
7. *Uranilla regina* Stearns, 34.0, max. diam.
8. *Chlorostoma gallina* var. *multifilosa* Stearns, 36.0.
9. *Chlorostoma gallina* var. *multifilosa* Stearns, 34.0, max. diam.



WEST AMERICAN MOLLUSKS.

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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No. XXV.—REPORT ON THE MOLLUSK-FAUNA OF THE GALAPAGOS ISLANDS WITH DESCRIPTIONS OF NEW SPECIES.

BY

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(With Plates LI, LII.)

The following list of the land and marine shells of the Galapagos Islands is based principally on the collection made by Prof. Leslie A. Lee and his assistants on the voyage of the U. S. Fish Commission Steamer *Albatross* from Chesapeake Bay by the way of the Straits of Magellan to San Francisco in 1887–'88. Without any attempt to make an exhaustive review of the mollusk-fauna of the group, or even to make a list that would be a complete compilation or catalogue, I have included the principal collections from authentic sources heretofore made known or published, and have added such comments and notes as have occurred to me in the course of my examination of the Galapagos material collected by the *Albatross* and such other examples as are contained in the collection of the U. S. National Museum. It should be borne in mind that this report refers, so far as the marine mollusks are concerned, with a few exceptions, to the littoral and shallow-water species only. The deep-sea material remains to be investigated and reported upon hereafter by Dr. Dall; the few species he has already described are included in the summarized list in the latter part of this report.

GEOGRAPHICAL AND PHYSICAL CHARACTERISTICS.

A brief description of the geographical situation and physical characteristics of the islands of this group may be of some interest in connection with what follows. The Galapagos are a group of islands in the Pacific ocean, about 600 miles to the westward of the coast of Ecuador, to which State they belong. They lie on both sides of the equator, extending from about 2° north to 1° 30″ south latitude, and between 89° 20″ and 92° 10″ west longitude from Greenwich.

There are five principal islands, eleven smaller ones, and a great number of islets and rocks. The larger islands, situated between the

equator and 1 degree south, are Narborough, Albemarle, James, Indefatigable, and Chatham. Of these Albemarle is the chief; it is the only one cut by the equator, is 75 miles long and about 15 in breadth, and its highest summit, according to Humboldt, is 4,636 feet above the level of the sea. Of the smaller islands, three are between the equator and 1 degree south—Jervis, Duncan, and Barrington; three between 1 degree and 2 degrees south—Brattle, Charles, and Hood; and five between the equator and 2 degrees north—Tower, Bindloe, Abingdon, Wenman, and Culpepper; the last only about a mile in length by five-eighths of of a mile in width. As before stated, the highest elevation occurs on the largest island, Albemarle, 4,636 feet; next is Narborough, about 4,100; others vary in altitude from these figures to Tower island, which only reaches an elevation of about 229 feet above the sea level.

VOLCANIC ORIGIN.

The entire group is of volcanic origin, and most of the islands consist of basaltic rocks and masses of scoriæ and lava. "Scarcely anywhere else," says Humboldt in his Cosmos, "on a small space of barely 120 or 140 geographical miles in diameter, has such a countless number of conical mountains and extinct craters (the traces of former communication between the interior of the earth and the atmosphere) remained visible." Darwin, who visited the Galapagos in the expedition of the *Beagle*, calculated the number of the craters at nearly two thousand, and two of the craters were simultaneously in a state of eruption. He wrote, "On all the islands streams of a very fluid lava may be seen, which have forked off into different channels and have often run into the sea." On Albemarle, "the cone mountains are ranged in a line and consequently on fissures." "Many margins of craters are formed of beds of tufa, which slope off in every direction." While these islands have been regarded as of very recent formation, some of them are said to exhibit the remains of an older volcanic formation; these indications occur "on Charles Island and the small islands Gardner, Caldwell, and Enderby, which surround it." "The structure of Albemarle,* made up of a series of at least five volcanic centers with the adjacent Narborough, gives us an indication of the probable appearance of the central and western groups of islands were they still active so as finally to become connected and form a huge island, with James, Indefatigable, Jarvis, Duncan, Barrington, and Charles as the culminating points of the plateau, formed by the 100 fathom line. We may therefore look upon the Galapagos Islands as a group of volcanic islands, gradually built up by successive flows of lava upon a huge mound, itself perhaps raised by the same agencies from the floor of the ocean; more active local flows in the same region having at special points built up more rapidly the northern group of islands—Wenman

* A. Agassiz, in Bull. Mus. Comp. Zoöl., Vol. XXIII, No. 1.

and Culpepper, and the two other groups of islands we have recognized."

* * * * * * *

"While slowly steaming through the archipelago from island to island we had an excellent opportunity of studying the natural features of these islands, and also as we passed their shores or were dredging within a moderate distance. As far as a cursory examination like ours could prove anything regarding the nature of the geological structure of the islands, our observations fully agree with those of Darwin and of Wolf, that this group presents one of the best examples of true volcanic islands.

"The majority of the islands are evidently formed around a central crater or center of elevation. They have increased in size and in height from successive lava flows. There is nothing to show that the separate islands are entirely the result of the disintegration of a larger volcanic chain, though of course a certain amount of denudation and submarine erosion has undoubtedly taken place, as is readily seen on the slopes of the islands and on examination of the soundings between them. Neither do we find any indications either of elevation or of subsidence of any part of the area of the Galapagos district which would affect their topography; and, as Wolf maintains, we can still less explain their formation by a separation in former periods from the South American continent. On the contrary, every part of their structure seems to prove that the islands have been slowly formed by submarine eruptions at first, and subsequently by similar accretions at the level of the sea, until finally some of the islands have reached an elevation of over 3,000 feet. During the process of growth some of the islands have become joined together, as for instance Albemarle, which is probably composed of three islands originally independent, and also the eastern and western parts of Chatham, which were surely once two separate islands, and are now connected only by a low isthmus.

"The volcanic activity of some of the islands has continued to comparatively very recent times. I am informed by Mr. Cobos that smoke has been seen to issue from Narborough as late as 1836, and it is well known that Capt. Collet was driven from Tagus Cove by the heat due to an eruption on the neighboring Narborough. It is quite probable that the age of the Galapagos does not reach beyond the earliest Tertiary period, and many parts have undoubtedly not been formed before the present epoch, so that the time is geologically short during which so many plants have developed from their South American, their Central American, their Mexican, or their West Indian ancestors." *

CLIMATOLOGY AND FLORAL ASPECT.

As would be supposed, the climatology of these islands is peculiar. Though situated directly on the equator, it is not excessively hot, being

* A. Agassiz.

modified by the comparatively low temperature of the surrounding sea. The rain occurs between February and June, but is very irregular, and often there is none for one or two years. In the higher portions of the islands, about 900 feet, there is often rain all the year. The zone up to between 500 and 600 feet is nearly without rain; therefore the upper region remains always green, the lower is arid and barren. At the edge of the sea various maritime plants occur and in some of the bays mangroves, etc. In ascending the hills from the shore the whole ground in all directions is covered with apparently withered bushes, but on a closer examination it is found that these plants are mostly in bloom. This brushwood grows up to a height of 5 or 6 feet, rarely 10 feet, and here and there are found *Algoroba* trees about 20 feet high, and also sporadic Palosantos (*Guiacum*), the latter being the largest tree in the lower region; it reaches a height of 30 feet and 3 feet in circumference. On places which do not allow the growth of any other plant, the grotesque, tree-like *Opuntias* and gigantic *Cereus* are found. The *Cereus* is generally seen in the most barren spots. These cactuses give a very characteristic appearance to this region. Besides these plants there are some fifty or sixty others, principally shrubby. Then comes an intermediate zone, the vegetation indicating increased humidity; this latter is included between the altitudes of about 650 and 900 feet, and separates the dry and humid regions. This intermediate belt, between 200 and 300 feet in width, is still more covered with brushwood of a withered appearance. The cactuses disappear and a trailing tree moss (*Usnea*) becomes the characteristic feature, and is easily distinguished from a distance by its white color. When the high plateau above the 900 foot line is reached the whole scenery changes; a refreshing, moist breeze comes from the coast; the traveler is surrounded by green woods and stands on meadows. These woods are principally of trees 30 feet high, of an Andean type, and the flora of Ecuador at an altitude of, say 10,000 feet, is suggested at an elevation of only one-tenth as great; there is great resemblance to the small Paramo forests of the Andes, not only in the habits of the trees but also in the small plants which cover the ground, and in the mosses and lichens which cover the trees. The woods are free, without creeping plants, making a passage easy; small meadows occur, consisting nearly entirely of grasses and rushes (*Cyperaceæ*). Above this wooded region another may be seen, which is destitute of trees and covered only with a coarse, short grass, which extends to the highest summits of the islands. (Chatham, Hood, Indefatigable, and James.)

The description of these various zones is based on the conditions found on Charles Island; it is said to be the same on the others of high elevation. From this it is evident that such islands as do not reach to the humid region, like Hood, Barrington, Tower, etc., show only the arid state.

DISTANCES AND DEPTH OF WATER BETWEEN THE ISLANDS.

The approximate distances between some of the islands are as follows:

	Miles.
Hood to Culpepper	270
Chatham to Narborough	163
Hood to Chatham	31
Hood to Charles	40
Chatham to Indefatigable	41
Albemarle to Abingdon	48
Abingdon to Bindloe	14
Bindloe to Tower	31
Abingdon to Wenman	88
Wenman to Culpepper	22
Duncan to Indefatigable	6
Jervis to James	5
Barrington to Indefatigable	11
Indefatigable to James	12
James to Albemarle	11
Charles to Indefatigable	31

"The deepest sounding on record is 671 fathoms (4,026 feet) between Tower and Indefatigable islands; between the Median islands the greatest depth does not surpass 300 fathoms, but a complete series of soundings may show quite different figures."*

Since the above was written by Dr. Baur we have additional data relating to the soundings in Agassiz's† paper, wherein he says:

"Our knowledge of the hydrography of the Galapagos is still quite incomplete. There are unfortunately no soundings between James and Albemarle, to indicate the probable depth of the ridges connecting them. Nothing likewise is known of the depth of the channels between Abingdon and Bindloe and Tower, and no soundings exist to show how far to the westward the deep valley (of over 800 fathoms) separating Bindloe from Indefatigable extends, as there are no soundings between either Bindloe or Abingdon and Albemarle. There seems little doubt that the northernmost islands, the isolated rocks of Culpepper and Wenman, are themselves separated by comparatively deep water, and in turn separated from the northeastern group of islands, Abingdon, Bindloe, and Tower, by a tongue of the ocean of at least 1,000 fathoms in depth and from 60 to 70 miles in width. From a careful examination of the soundings thus far made it seems probable that the 100-fathom line connects Indefatigable, Duncan, Barrington, and Charles, and that there is also a connecting ridge inside that same depth between those islands and Albemarle to the southeast of Cape Woodford on Albemarle, or a wider plateau of which Duncan Island is one of the culminating summits.

"A comparatively shallow connection may also exist between Cape

* Baur's paper, Am. Nat., 1891.

† A. Agassiz in Bull. Mus. Comp. Zoöl, Vol. XXIII, No. 1.

Nepean, on James Island, and Albemarle in the direction of Cowley Island, Narborough itself being only separated from Albemarle by a channel less than 75 fathoms in depth. The soundings between Chatham, Barrington, and Hood are so few in number that we are not yet able to decide whether these southeastern islands, Chatham and Hood, are not perhaps connected by a ridge connecting Hood and Macgowen Reef, and also uniting them with the great plateau which the islands of Barrington, Charles, Indefatigable, Duncan, Albemarle, Narborough, and perhaps James have gradually built up.

"But it may be that the tongue of deeper water extending between Hood and Chatham runs toward Barrington, and also separates that island from Chatham."

Agassiz further on says: "On account of the small number of soundings, no attempt has been made to draw curves of depth on the chart of the Galapagos."

ORIGIN THROUGH SUBSIDENCE.

The position of Baur is that "*the Galapagos are continental islands, originated through subsidence;*" they all formed at a past period one large island, and this island itself was at a still former period "in connection with the American continent." This is in direct opposition to the opinions of "Darwin, Hooker, Salvin, Grisebach, Englar, M. Wagner, Wallace, Peschel, and later by Wolf, and Agassiz, as herein quoted. All declare that these islands are of recent volcanic origin, that they have emerged out of the sea through volcanic activity, and have become peopled from the continent," etc. "Henri Milne Edwards alone holds a different opinion; he believes that the Galapagos represent the remains of a former continent, and in this opinion I agree." He then proceeds by saying that "the principal reason of the believers of the elevation theory is the volcanic condition of the islands. But I do not see any difficulty in that. If mountain ranges like the Himalayas, the Alps, the Andes, the Rocky Mountains, could be elevated thousands and thousands of feet, why could not subsidence take place in other places? If Central America should disappear by and by through subsidence, the result would be that the tops of the highest mountains would form volcanic islands, some with still active volcanoes. This would be exactly the condition we see to-day in the Galapagos. I think, therefore, that the volcanic nature of a group of islands is no positive proof of its recent origin. Such groups of islands can be just as well considered as formed of the tops of the volcanic mountains of a sunken part of a continent." * * *

"I believe, therefore, that the peculiar genera we find to-day on the Galapagos have not originated there, but have been preserved in their old condition." *

* Dr. Baur in Am. Naturalist, April, 1891.

ORIGIN OF FAUNA AND FLORA.

Dr. Baur's contention arises from the hypothesis that only subsidence can explain what he terms the harmonic distribution of animal and plant life. He says further on, "that we need only an elevation of about 10,000 feet to connect the Galapagos with America." The peculiarities of the flora which he points out and which are referred to elsewhere in connection with the arid and humid zones (ante, page —, he regarded as explicable only by the theory of subsidence; but it seems to me they are fully as well explained in Agassiz's paper, and so far as the alpine facies of the flora is considered, it may fairly in this respect be compared to that of the rainless belt of the South American mainland 600 miles to the eastward, and the modifying influences of cold on one side and drouth on the other may be regarded as producing analogous results in dwarfing and otherwise differentiating vegetable life. The theory of subsidence he assumes will explain all these, as well as similar and other phenomena which I have not referred to, "in an absolutely easy manner." It is very doubtful, however, in the present state of our knowledge, whether this, that, or the other theory will satisfactorily explain *all*, but that theory which will fairly explain a good portion, by those factors or agencies that are operating directly under our eyes, would seem to be preferable and entitled to acceptance over another, however plausible and attractive, that involves conjectural and remoter conditions. It seems to me that anyone who has given much thought and attention to the study of the geographical distribution of species, and has pursued it to such an extent as to justify the term investigation, upon a glance at any good map that presents the breadth and range of the great Peruvian current, its velocity and direction, and the contributing influence of the Mexican as well as the Panamic current, which latter no doubt is an important factor, and these combined including in their sweep and embrace the various islands which form this peculiar group, will readily perceive the geographical origin of the species that now inhabit them and the direction from which these islands were stocked or peopled. To the continuous or uninterrupted influence of these rivers in the sea, operating without intermission through indefinite centuries, as well as to the persistent agency of trade winds, storm winds, and more transient ærial currents, we may find a solution, or key, to say the least, to the greater part of the phenomena, without resorting to topographic displacement or modification of the sea bed of 10,000 to 12,000 feet elevation to explain the few that are less easy or more difficult of explanation.

MARINE MOLLUSKS.

Of the marine shells (257 species) less than half a score* are indigenous; of these some, if not all, may prove upon a better knowledge of the mollusks of the shores of Central and South America to belong

* Not inclusive of dredged or deep water species.

to the mainland. Our knowledge of the marine species along the South American coast is not by any means satisfactory. The collection made by Dr. Jones, of the U. S. Navy, which embraced 211 West coast species, carried 90 of them from 100 to 3,195 miles farther south than previously reported. *Tectarius*, of the *Litorinidæ*, previously detected at Hood and Bindloe by Dr. Habel as listed by Wimmer, was subsequently found at Manta, Ecuador by Dr. Jones,* and it is not unlikely that others now regarded as peculiar to the Galapagos may prove to be mainland forms. Attention is called to my remarks in the catalogue on *Omphalius Cooksoni* Smith and its close resemblance to, if not identity with, the Antillean *O. fasciatus*.

The number of species, however, that exhibit intimate relationship with Antillean-Caribbean forms, is quite small and inconspicuous, when placed side by side with the West American types.

DRIFT MATERIAL.

Pertaining to the drift material, its quantity and occurrence, the testimony of the sea bed claims special consideration. Referring to the "character of the bottom deposits," Agassiz remarks: "Nearly everywhere along our second line of exploration, except on the face of the Galapagos slope, we trawled upon a bottom either muddy or composed of Globigerina ooze, more or less contaminated with terrigenous deposits, and frequently covered with a great amount of decayed vegetable matter. We scarcely made a single haul of the trawl which did not bring up a considerable amount of decayed vegetable matter, and frequently logs, branches, twigs, seeds, leaves, fruits, much as during our first cruise.

"I was struck, while trawling on our second line between the Galapagos and Acapulco, to observe the great distance from shore to which true terrigenous deposits were carried. There was not a station there occupied of which the bottom could be characterized as strictly oceanic. At our most distant points from shore the bottom specimens invariably showed some trace of admixture with terrigenous material. A very fine mud was the characteristic bottom brought up * * * from depths of 2,000 fathoms. This mud continued all the way from the Galapagos to Acapulco, and up to the mouth of the Gulf of California, where it became still more an impediment to dredging, so that little work was done until we passed the Tres Marias. Even then the trawl was ordinarily well filled with mud, and with it came up the usual supply of logs, branches, twigs, and decayed vegetable matter. On going farther north, into the Gulf of California, the nature of the bottom did not change materially from what it had been along the coast," etc.

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*List of shells collected on the west coast of South America, principally between latitudes 70° 30′ S. and 8° 49′ N., by Dr. W. H. Jones, U. S. Navy. Proc. U. S. Nat. Mus., Vol. XIV, pp. 307-335, 1891.

* * * "In the dredgings of the *Blake* in the Gulf of Mexico, off the West Indies, and in the Caribbean, my attention had already been called to the immense amount of vegetable matter dredged up from a depth of over 1,500 fathoms on the lee side of the West India Islands. But in none of the dredgings on the Atlantic side of the isthmus did we come upon such masses of decomposed vegetable matter as we found on this expedition. There was hardly a haul taken which did not supply a large quantity of water-logged wood, and more or less fresh twigs, leaves, seeds, and fruits, in all possible stages of decompositions." * * *

WEST AMERICAN CURRENTS.

Again referring to Agassiz, he says: "The course of the currents along the Mexican and the Central and South American coasts clearly indicates to us the sources from which the fauna and flora of the volcanic group of the Galapagos has derived its origin. The distance from the coast of Ecuador (Galera Point and Cape San Francisco) is in a direct line not much over 500 miles, and that from the Costa Rica coast but a little over 600 miles, and the bottom must be for its whole distance strewn thickly with vegetable matter, which, as I have already stated, came up in great masses in almost every haul of the trawl. This was especially noteworthy in the line from the mainland to Cocos Island, and certainly offers a very practical object lesson regarding the manner in which that island must have received its vegetable products. It is only about 27.5 miles from the mainland, and its flora, so similar to that of the adjacent coast, tells its own story." "The velocity of the currents in the Panamic district is very great, sometimes as much as 75 miles a day, so that reeds, fruits, masses of vegetation harboring small reptiles, or even large ones, as well as other terrestrial animals, need not be afloat long before they might safely be landed on the shores of the Galapagos. Its flora, as is well known, is eminently American, while its fauna at every point discloses its affinity to the Mexican, Central, or South American, and even West Indian, types, from which it has probably originated; the last indicating, as well as so many of the marine types collected during the expedition, the close connection that once existed between the Panamic region and the Caribbean and Gulf of Mexico; a connection once extending, probably, through deep and wide passages all the way from the northern extremity of Colombia, the Isthmus of Panama, Costa Rica, and as far north as the Isthmus of Tehuantepec."

TERRESTRIAL MOLLUSKS.

The land shells are principally of a Bulimoid type and of a distinctly American aspect. One of the twenty or more so-called species, *Bulimus achatinellinus* of Forbes, has in the brightness of its coloration,

its color markings, and the sheen and smoothness of its surface a close resemblance to some of the Polynesian *Achatinellas;* but it lacks the chief and constant character of the Achatinellas, viz, the ever-present and persistent twist of the columella at its base. As may be seen upon examination of the tabulated list hereunto annexed, the land shells therein are assigned definitely to *only eight* of the islands, viz: Albemarle, Indefatigable, Barrington, Charles, Hood, Bindloe, James, and Chatham. It is greatly to be regretted that our knowledge of the terrestrial mollusks of the group is so exceedingly limited. What might be the result of a systematic investigation, island by island, and zone by zone, and the environmental peculiarities, general and local, carefully observed and noted, we can barely conjecture; but we are warranted in assuming from the testimony of the limited material under review, and what is known of the relation of environment to variation in the land shells in other parts of the world, that an ample collection under the conditions above mentioned would be of very great value to the biologist and full of interest from a more general scientific point of view.

The various species of Galapagos land shells are in the main of dull, unattractive colors; this might be supposed when the circumstances of their occurrence are considered. Of a few of the species the collector noted the peculiarities of station, and we read of this or that species as occurring "under scoriæ," "under lava," etc.; again of *B. nux*, which exhibits extreme variability and is apparently the most numerous in individuals, as being found "on bushes" or upon or under lava. To the student who has this material, or this class of material, before him these few brief notes are especially suggestive, and remind him of the exceeding variability frequently exhibited within the compass of a comparatively limited area. An investigation of the higher altitudes of those islands that attain an elevation sufficient to include the "intermediate belt 200 and 300 feet in width," what may be called the *white zone* or zone of *Usnea*, and, still higher, the plateau region or *zone of green* woods and meadows, would doubtless show that said zones were inhabited each by its own peculiar species and color types, characteristic of or to the zone, peculiar and characteristic in external facies at least, such as color and sculpture, if not strikingly or materially different in that of form. In the upper or *green zone* it might be found that the mollusks were arboreal in their habits, of bright colors, like Forbes's *B. achatinellinus* heretofore mentioned, and like the more showy of the numerous species of the Sandwich Island *Achatinella*,* which inhabit a similar station.

The land shells, as before stated, are definitely referred to eight of the islands. So our knowledge of the marine species is restricted to eight,

* The dull-colored species of this Polynesian group of shells live generally, if not exclusively, on the ground or near it—that is to say, are not arboreal, as I was informed by my esteemed friend the late Dr. Newcomb many years ago.

viz: Hood, Albemarle, Charles, Duncan, Bindloe, James, Chatham, and Indefatigable.

It may be said perhaps that the presence of the marine molluscan forms of the West American coast is much less difficult to account for than either of the other faunal elements.

DISTRIBUTION OF TERRESTRIAL SPECIES.

The distribution of the terrestrial species both by fluviatile and marine currents as well as by aerial forces is easily explained. It includes necessarily a consideration of the vitality of these animals as well as of their eggs.

Binney,* referring to the introduction of foreign species into the United States, says: "Oceanic currents also aid in bringing to our shores foreign species, and have been the means of introducing and naturalizing them. The Gulf Stream is a prominent example of this. This great body of water, flowing from the Gulf of Mexico into the Atlantic, passes between the peninsula of Florida and the island of Cuba, and after turning the southern point of Florida sweeps along its eastern shore. It is sometimes driven close to the northern coast of Cuba, and sometimes forced much farther north, according to the direction and force of the wind. Various countercurrents, due also to the influence of the wind, diverge from the main stream, among which is noticed a current, which, after a northerly wind has prevailed for several days, sets in a southwesterly direction near the Florida Reef. The principal stream and the currents originating in it bear upon the surface various vegetable and other productions brought by rivers into the Gulf or swept from its shores, and these are frequently deposited upon parts of the coast very distant from their origin. In this way seed vessels from the Spanish Main, trunks of trees, and fragments of wood of unascertained origin, and numerous objects from the northern shore of Cuba are frequently found on the shore of Key West and on the beach of Cape Florida and the shores and islands to the north of it.

"A few years since a bottle was picked up on Tavernia Key, near Cape Florida, containing a note stating that it was thrown overboard off the Moro Castle. A Cuba barge, of the kind used in lading and unlading vessels in Matanzas, was lately found stranded on the beach at New River, 25 miles north of Cape Florida. Small objects from Cuba are often found on the shore of Key West.

"These circumstances are adequate to account for the transmission of land shells from the island of Cuba, and even from more distant places, to the mainland and islands of Florida; and to this source we ascribe the origin of *Helix rhodocheila*, and *Bulimus virgulatus*, which

* Terr. Moll. and Shells of the United States (A. Binney) Vol. I, 1851, p. 152 *et seq.* (edited by A. A. Gould).

are probably derived from the Bahamas, but possibly from the Spanish Main, and of *Helix ottonis*, *Bulimus fasciatus*, *B. zebra*, *B. subula*, *Pupa incana*, *Cyclostoma dentatum*, and *Cylindrella lactaria*, all undoubtedly from Cuba, which, having found a congenial soil and climate in the southern part of the peninsula of Florida, are now flourishing there in great numbers. To the same cause may possibly be due the passage of some of the smaller species, of universal diffusion in the United States, to the island of Cuba. Among these are *Helix minuscula*, *Pupa contracta*, and *P. rupicola*, which from their general distribution on the continent may be supposed to have originated there rather than upon the island.

"We can not help thinking, too, that such currents have had some agency in introducing *Helix hortensis* on our northeastern coast at some former period, although we are not aware of the existence of one capable of producing such an effect."

FRESHETS AND OCEAN CURRENTS.

* * * * * * *

"That this hypothesis of the agency of currents is no violent one, is proved by common experience. A single log of timber, removed from the bank of a river by the rise of its waters during a *freshet*, and borne by them to the ocean, and driven by winds, tides and currents, might carry with it and deposit upon other shores the eggs of mollusks, or even the living animals themselves, provided they were not too long exposed to the elements. It is difficult to estimate their powers of endurance under such circumstances, or to limit the amount of exposure which they might bear, but they are unquestionably such as to enable them to sustain life for several days, in the case we have supposed. Logs and trunks of trees which have drifted from a great distance may often be seen upon our sea beaches; and we remember, on one occasion, to have seen Nantasket beach, at the mouth of Boston harbor, strewn with logs which had been driven from the rivers of Maine by easterly winds of several days' continuance."

EXTRAORDINARY SEASONS.

During the extraordinary winter of 1861–'62, when the interior valleys of California and the other seaboard regions of the west coast were turned into lakes through excessive rainfall in the lower altitudes and the melting of the previous snowfall in the higher regions of the mountains, for weeks the rivers were unable to carry off, within the capacity of their ordinary channels or drainage troughs, the enormous volume of water; every brook became a river, and the rivers were changed into raging torrents, undermining the banks, cutting new paths, and sweeping along on the way to the sea, forest trees of a century's growth, which were carried far into the ocean and borne

hither and thither by the currents and the winds. The greater part after drifting hither and yon were ultimately swept landward again by the prevalent westerly or northwesterly winds, and piled up helter-skelter upon the beaches all along the coast, forming a complete labyrinth and tangle or mesh work, of frequently enormous strands, and in the majority of cases absolutely concealing the beach itself for its entire width, from the water's edge to the extreme upper limit of the highest drift line.

Recent (December, 1892) west-coast papers say: "The *Wolcott* reports that in the recollection of seafaring men on the coast there has never been so many drift logs in the Straits of Fuca as at the present time. The high freshets have swept down the fallen logs of ages and sent them adrift to the sea. Logs that have been buried in the sand for years along the beach below Port Crescent have been washed up, and in some places great dams of logs are formed, rendering it dangerous for navigation."

AGENCY OF RIVERS, ETC.

Hooker, while discussing (Trans. Lin. Soc., 1851, Vol. xx, p. 163) the affinities of the flora of the Galapagos and its origin, lays great stress upon the action of the currents coming north from the Guyaquil River, and those flowing westward from the Bay of Panama, as agents for the distribution of South and Central American plants. Speaking of the affinities of the plants of the Galapagos he says: "The new species being for the most part allied to plants of the cooler parts of America or the uplands of the tropical latitudes, the more peculiar are the same as observed chiefly in the hot and damper regions, as the West Indian Islands and the shores of the Gulf of Mexico."*

Again, referring to the extraordinary winter of 1861-'62 in California, or more properly in the Pacific seaboard States, it will be seen at a glance that with westerly currents and not unfavorable winds the drift trees and logs brought down by the streams would have been swept on and borne elsewhere, instead of being piled up along the beaches of Oregon and California, or would have continued to drift until they became water-logged and sunk. Nor was the havoc made in the forests caused chiefly by the main streams. Streams no larger than Russian, Smiths, and Klamath Rivers, of insignificant volume in ordinary years, were changed into devastating torrents and contributed largely to the general destruction.

In Chile there are between twenty and thirty streams of from 70 to over 200 miles in length, rivers of rapid descent, that drain off and carry more or less directly to the sea the water resulting from the melting snow of the Andes. The ordinary volume of these rivers is sometimes enormously increased by the winter rains, and occasionally a

* Quoted by A. Agassiz, as previously indicated.

winter or rainy season occurs of unusual and extraordinary precipitation when the swollen currents exhibit torrential energy.*

Peru has numerous streams in common parlance of insignificant proportions and of little value for other than irrigating purposes. These, too, in seasons like the above, become important by reason of the damage resulting from their catastrophic action.

And still farther to the north, along the westerly slopes that drain into the Pacific, we may reasonably assume contributions are made to the general drift material that rivers ordinarily carry to the sea, and which, being within the range and influence of the west Mexican current, are likely ultimately, in part at least, to be borne seaward along its westerly course.

A single tree of large size might carry with it not only molluscan and insect forms mature, living, or in the egg, of several species, but also living individuals of many vertebrate forms that found refuge or safety upon it, somewhere along its course from its native forest home to the point where it found final lodgment, or was cast ashore; thus if the environmental conditions were at all favorable, would be planted the foundation of a colony which would extend its territory so far and in such directions as were most congenial. The area of surface above the water furnished by the main trunk of such a tree, and the drift consisting of various material entangled in and among its branches, would be amply sufficient in the matters of space and security, for the transportation of many animal forms; of these such as possessed sufficient vitality to successfully meet the contingencies of the voyage in the way of hunger, thirst, etc., would become the progenital stock in new regions more or less distant from their original haunts, where, under the steady but moderate pressure of new environmental conditions, in the course of generations a new *facies* would be gradually brought about, developed in or given to the more plastic, and we should have what are called new species.

GENERATIVE CAPACITY AND VITALITY OF LAND SNAILS, ETC.

The prolific generative capacity of the land snails and their extreme tenacity of life are to be considered in connection with their geographical distribution and establishment in new areas under the circumstances and conditions described above, as well as in the matter of probable aërial distribution, which last has never received sufficient consideration as playing an important part, or any part whatever, as an agency in dispersing or distributing animal life or extending specific areas or creating new ones remote from those previously existing.

"The number of eggs produced varies in the genera and species," says Binney, "in the same proportion as the dangers to which they

* It was the occurrence of such a winter as this that destroyed the botanical garden of my friend the late Thomas Bridges, whose establishment was within flood range of one of these Chilean streams.

are exposed are greater or less. Thus in the *Limacidæ*, whose means of protection and whose chances of preservation are much less than those of the *Helicidæ*, the number is much greater than in the latter. The number of eggs produced by two individuals of *Limax agrestis* kept in confinement by Dr. Leach was, in the course of rather more than a year, seven hundred and eighty-six. It usually amounts to at least three hundred per annum. The other species, though not equally prolific, multiply greatly; and each pair of the various species of *Helicidæ* produces, annually, from thirty to one hundred eggs, and perhaps more. The young of the *Limacidæ* complete their growth and reproduce their kind sometimes within the year of their birth, and always as soon as the second year; and the species of the other families are believed not to require a much longer time to attain maturity. This rapid increase replaces the numbers annually destroyed, and maintains the species in their relative importance.

"Their extreme tenacity of life is manifested in every stage of growth from the egg to the mature animal. In the northern part of the United States we have frequently observed the eggs of the *Helicidæ* in the forest covered with snow, protected only by a single leaf, where they had remained through the winter months, constantly exposed to a temperature much below the freezing point. The *Helicidæ* themselves withstand the cold of the severest winters in the same situations, and *Succinea* has been frozen in a solid block of ice and yet escaped unharmed. Helices when frozen in a state of confinement, though they sometimes recover so far as to move about with some activity, usually survive but a short time.

* * * * * * *

SUBSISTING WITHOUT FOOD.

"The great length of time they can subsist without food is another exemplification of their great tenacity of life. Those species, especially which live in dry and exposed situations, have the power of endurance to a remarkable degree. A friend received specimens of *H. desertorum* which had been collected in Egypt, had been shipped to Smyrna, thence to Constantinople, thence to Rio Janeiro, and finally to Boston, occupying a period of about seven months, which appeared in full vigor when taken from the papers in which they had been enveloped. They were laid away in a drawer, and on being examined three years afterwards some of them still came out in tolerable vigor."

Further instances of the extraordinary vitality of the land snails have come under my own observation, and these are more directly pertinent because the species referred to are West American, and inhabit areas where the physical features are more nearly like those of the South American mainland, and that particular zone of the same from whence no doubt the Galapagos islands were originally stocked.

In December, 1865, the Stearns collection, now in the National

Museum, was enriched by the acquisition of several examples of *Helix Veatchii** Newcomb, that were collected by Dr. Veatch on Cerros or Cedros Island off the coast of Lower California in 1859. The specimens were given by Dr. Veatch to Thomas Bridges, and upon the death of the latter came into my possession with the remainder of the Bridges shells. One day upon a careful examination I discovered that one of the specimens was apparently still alive, and placed it in a box of moist earth; after a while it protruded its body from the shell and commenced moving about and seemed to be no worse for its long fast of at least *six years*. *H. Veatchii*, it will be observed, beat the time of the famous British Museum example of *H. desertorum*, which lived without food within a few days of *four years*. In March, 1873, Prof. George Davidson, of the United States Coast Survey, while at San José del Cabo, Lower California, collected a number of specimens of *Bulimus pallidior*, and subsequently gave me a part of them, which I put in a box, where they remained undisturbed until June 23, 1875, when they were placed in a glass jar with some chick-weed and a small quantity of tepid water. They soon waked up and began to move about apparently as vigorous as ever after their long nap of *two years two months and sixteen days*. In connection with the foregoing it should be borne in mind that at the commencement of hibernation the land snails seal up the aperture of the shell with a close-fitting shield or epiphragm; this consists usually of thin transparent mucus, at other times, and more especially with those forms that inhabit arid regions, of an opaque membranaceous matter of the thickness of thin card board; the animal protects itself still further by other and interior epiphragms, that, like so many partitions, still further protect them against prolonged or excessive heat or aridity. It should also be noticed that color also has some place in this connection, for although most if not all of the land shells that inhabit hot, arid, or sterile regions, seek protection from the heat by burrowing, the prevailing color of such species is white or whitish, rather than dark or black; the first reflecting the heat instead of absorbing it, as is the case with the latter. It may be that sufficient or perhaps too much space has already been given to these incidental or secondary matters, nevertheless before leaving this aspect of the subject the following from Woodward † is worth quoting:

FURTHER INSTANCES OF TENACITY OF LIFE.

"The fresh-water molluscs of cold climates bury themselves during winter in the mud of ponds and rivers; and the land snails hide themselves in the ground or beneath moss and dead leaves. In warm climates they become torpid during the hottest and driest part of the year. Those genera and species which are most subject to this 'sum-

* Now regarded as a variety of *H. areolata*.

† Recent and Fossil shells.

mer sleep' are remarkable for their tenacity of life; and numerous instances have been recorded of their importation from distant countries in a living state. In June, 1850, a living pond mussel was sent to Mr. Gray from Australia, which had been more than a year out of water. It was alive four hundred and ninety-eight days after it was taken from the pond, and in the interim had been only twice for a few hours in water, to see if it was alive.

"The pond snails (*Ampullariæ*) have been found alive in logs of mahogany from Honduras (Mr. Pickering), and M. Caillaud carried some from Egypt to Paris, packed in sawdust. Indeed, it is not easy to ascertain the limit of their endurance; for Mr. Laidlay having placed a number in a drawer for this purpose, found them alive after five years, although in the warm climate of Calcutta. The Cyclostomas, which are also operculated, are well known to survive imprisonments of many months; but in the ordinary land snails such cases are more remarkable. Some of the large tropical Bulimi, brought by Lieut. Graves from Valparaiso, revived after being packed, some for thirteen, others for twenty months. In 1849 Mr. Pickering received from Mr. Wollaston a basketful of Madeira snails (of twenty or thirty different species), three-fourths of which proved to be alive after several months' confinement, including a sea voyage. Mr. Wollaston has himself told us that specimens of two Madeira snails (*Helix papilio* and *tectiformis*) survived a fast and imprisonment in pill-boxes of two years and a half, and that a large number of the small *Helix turricula*, brought to England at the same time, were all living after having been inclosed in a dry bag for a year and a half."

THE AGENCY OF THE WINDS.

The distribution of plants through the agency of the winds, by means of which the seeds are dispersed and borne directly or indirectly to great distances, has been recognized for years and years, while the same distributive factor as operating in the dissemination of animal life has scarcely attracted attention or received the recognition it deserves. Showers of "sulphur" have frequently been reported at a distance of 200 miles or more to the westward of the Atlantic seaboard where the yellow pollen of the pines standing in the barrens of New Jersey has fallen and been deposited, in many places, to a perceptible depth. Showers of dust or sand from the desert of Southern California are swept northerly or westerly for great distances, first carried to a high altitude by the ascending column of heated air, and the desert sands of Sahara are sometimes lifted by similar means and carried northward from Africa across the Mediterranean.

Squids and fishes, inhabitants of the sea, that have been carried up by waterspouts are borne landward by storm winds or gales, and fall to the earth in distant places, to the astonishment of the intelligent as well as the superstitious, and the cyclone, so called, or hurricane of the

Indian seas and elsewhere, sometimes of several hours' duration and of terrific force, must, in the nature of things, include in the material uplifted and swept before them, animate as well as inanimate objects. No part of the earth's surface, probably, is free from the occasional visitation of these violent storms, though their occurrence is much more frequent in some regions than others. "Volcanic dust," from the eruption of a volcano on the island of St. Vincent, West Indies, fell on an island 95 miles to the windward in such quantities that trees were crushed to the earth by the weight of the mass."* The eggs of most snails are not heavier than particles of volcanic dust or desert sands or, perhaps, the pollen of the pine, and may be moved separately or as attached, either to aerial drift or the current drift of the sea.

The more general region which includes within its area the Galapagos is said to be free from severe storms; it is highly probable, however, that in the course of years storms of great severity do occur, and it is quite unlikely that any portion of the earth's surface is absolutely exempt from occasional visitations of this character. With the high velocity that not infrequently marks severe meteoric disturbances, a storm of very short duration would be sufficient to carry literally on "the wings of the wind" plant seeds as well as the minute eggs of animals or the larvæ of insects over distances no greater than that between the Galapagos and the mainland.†

I have quoted, in the main literally, from Baur, Agassiz, Binney, etc., in order to present to the reader, more particularly the student interested in the study of the Mollusca, the more important physical features exhibited in this interesting group of islands, their geographical isolation remote from the mainland of the American continents, their still greater distance from any of the Polynesian islands, as well as the more local physical characteristics, and the difference observable among the various islands when brought into comparison one with another.

Class PELECYPODA.

Family OSTREIDÆ.

Genus **OSTREA** Linne.

1. Ostrea folium Gmel.

Two valves; different individuals.
James Island.

* Dr. Sharp, in Proc. Acad. Nat. Sci. Phila., 1890.

† The Paumotu group, supposed to be entirely outside of the cyclone belt, which includes the Samoan and Fiji groups, was swept by a fierce cyclone in 1878; and the same storm extended to the Society Islands. The oldest natives had not even a tradition of such a storm occurring before in the Paumotus.

While reading the proofs of this paper the daily papers have contained notices of a disastrous hurricane on the coast of Chile, by which the mole at one of the nitrate ports was carried away and damage at this point was done to the extent of $150,000.

These valves evidently belong to a species that inhabits the littoral zone, and to examples that inhabit the upper belt of said zone, and fasten upon small stones or to the roots of mangroves or some other shore-inhabiting shrub. Of the many species that have been described from the west coast quite likely one-half are synonyms.

The form of individual examples, as well as of the several individuals that constitute a colony, is so dependent upon the object to which the individual or the mass is attached, that a satisfactory diagnosis is out of the question with anything less than a large series and a multitude of specimens.

Wimmer credits one of Gould's species, *O. glomerata* (*vide* Reeve's Monograph Conch., Icon., Figs. 52, a, b, c, d), to the Galapagos, but Reeve makes no reference to any species of oyster in these islands, and it may therefore be assumed that in the Cumingian collection these islands were not represented. *O. glomerata* is, for an *Ostrea*, a rather well-characterized species, and Reeve's figures are in this instance particularly good, so that it may be assumed that Wimmer's determination, if made from direct comparison with Reeve, is most likely correct; nevertheless I am disposed to doubt the presence of *glomerata* in the Galapagos until confirmed by further testimony or additional material. *O. glomerata* is rather an Indo-Pacific form, extending northerly and westerly to the islands of Japan. It is probable that Gould's *mordax*, collected by ("Wilson's Expedition" in Reeve, in error for) Wilkes's Expedition, and doubtfully assigned to California, is really a West Coast form; by some authors it has been regarded as a synonym of "*glomerata*." I can conceive of varieties of *mordax* closely approaching "*glomerata*," but in general features only.

Family ANOMIIDÆ.

Genus **Anomia** Linné.

2. **Anomia adamus** Gray.

=*A. Lampe* Gray, variety.

One left valve, beach, in good condition.

James Island.

Of the numerous alleged species figured in Reeve, *A. adamus* is the only one credited to the Galapagos, where Cuming obtained the example described by Dr. Gray near Lord Hood's Island, at the depth of 9 fathoms, attached to "*Avicula margaritifera*." If the description had been without the habitat, I should have recorded the specimen herein listed under the name of *A. lampe*, the latter being familiar to collectors generally, and usually attached to the species in collections.

In the Proceedings of the Zoölogical Society of London for the year 1849, Dr. J. E. Gray described (pp. 116, 117) seven species from the west coast of the Americas, including the foregoing, to wit: *fidenas*, *pacilus*, *larbus*, *alectus*, and *hamillus*. Dr. Carpenter, in his Check-

List of West Coast Shells, includes *lampe* and *fidenas;* the latter is described by Gray as "flat, smooth externally," etc. It is possible that *larbus* from Payta may be a distinct species, but I doubt it. Like *fidenas*, it is described as "smooth," but neither color, sculpture, form, whether exhibited in outline, convexity, or flatness, are of any permanence or of much value as diagnostic characters in this group; form, as to outline, convexity, or flatness, is entirely dependent upon the object which the individual *Anomia* has fastened upon. If it happens to be a *Pecten*, then the ribbing which characterizes the scallop shells is reproduced in the *Anomia*. If the young *Anomia* fixes itself in a deep or shallow concavity, or upon the surface of a slight or pronounced convex object, the shell in the course of its growth will be molded accordingly. Where they fasten upon large, smooth cobbles, in a sheltered nook of the coast, protected from rough seas, they are usually flatter and of more even and regular growth. Neither are the muscular scars to be depended upon, as a valid character for species-making, as anyone can see who has a sufficient quantity of material and will compare the same with Gray's descriptions before him. Carpenter, as before noticed, has adopted *lampe* and *fidenas;* these may for convenience be retained, the latter for the smooth variety, the former for the standard and usual examples, while the remainder of Gray's names may follow in the order of synonyms.

Family PECTENIDÆ.

Genus **PECTEN** Müller.

3. **Pecten subnodosus** Sby.

Four right and one left valves, all juniors and in good condition (Mus. No. 102519).

James Island.

The examples are from 1¾ to 2 inches high and have twelve to fourteen ribs.

Family LIMIDÆ.

Genus **LIMA** Bruguiere.

4. **Lima arcuata** Sby.

One broken valve.

James Island.

Family AVICULIDÆ.

Genus **PERNA** Bruguiere.

5. **Perna Chemnitziana** Orb.

= *Isognomon Chemnitzianum* Auct.

Two beach valves, one from each place.

Indefatigable and Hood islands.

Wimmer's list includes *I. legumen* Gmel. and *I. quadrangulare* Reeve, but it will be admitted by anyone familiar with the shells of this

genus that the determination must be more or less arbitrary. The *Albatross* specimens do not differ essentially from the Panama and Gulf of California form, which both C. B. Adams and Philip Carpenter determined as Orbigny's species. It is probably the same as *flexuosa* Sby., as stated by Carpenter, to whose comments in the "Mazatlan catalogue" reference is suggested.

Family MYTILIDÆ.

Genus **MYTILUS** Linné.

6. **Mytilus multiformis** Cpr.

Valves, beach (Mus. No. 102353).

Hood Island.

This species was described by Carpenter from Mazatlan shells, and the Galapagos valves are apparently identical. Dr. Jones detected perfect examples and odd valves of *M. cuneiformis* (=*M. angustanus Rve.*) at Chatham Island.

Genus **SEPTIFER** Recluz.

7. **Septifer Cumingianus** Dkr.

One valve, beach (Mus. No. 102352).

Hood Island.

Cuming collected this species at Panama and Carpenter includes it in his Mazatlan list.

Genus **MODIOLA** Lamarck.

8. **Modiola capax** ? Cpr.

One example, very small, beach.

Hood Island.

Probably, but not certainly, the above species, which is credited to the Galapagos in the Cuming collection now in the British Museum.

Family ARCIDÆ.

Genus **ARCA** Lamarck.

Subgenus **BYSSOARCA** Swainson.

9. **Arca (Byssoarca) solida** Sby.

Valves, beach (Mus. No. 122131).

Indefatigable Island.

10. **Arca (Byssoarca) gradata** Brod. & Sby.

Valves on beach.

James, Hood, Indefatigable, and Chatham islands.

Three perfect valves from James Island, one in good condition from Chatham, and one broken valve from Indefatigable; also one from Hood Island.

11. Arca (Byssoarca) Reeviana Orb.

Common, beach, valves.

Hood Island, common on beach. Indefatigable Island, thirteen odd valves, and James Island twenty-three valves, on beach.

This species is quite constant in sculpture of both hinge area and and exterior surface of valves, and the hinge teeth are characteristic and quite persistent; the outline of the valves is variable, as the byssal foramen is often carved out nearly exclusively from one valve. The largest example measured 4 by 2½ inches.

Family CARDITIDÆ.

Genus **CARDITA** Bruguiere.

Subgenus **Venericardia** Lamarck.

12. Cardita (Venericardia) flammea Michelin 1830.

= *C. flammea* Auct.
+ *C. varia* Brod 1832,
+ *C. tumida* Brod.
= *Actinobolus flammeus* Auct.

Valves, beach.

Common on James Island where numerous, principally right, valves were obtained; three valves Hood Island. Reeve says that "it is with no little gratification that I now publish a good illustrative figure of a species described thirteen years since by M. Michelin from a worn odd valve. The *Cardita varia* is the nearest allied species to it, but that shell is of smaller dimensions, rounder and slightly noduled; the painting is also of a different character."

After a careful comparison I feel warranted in uniting the three species as above under Michelin's name. I am quite familiar with these forms and the color distinction is of no value. These shells vary considerably in the other characters to which Reeve refers; but in the essential features of outline, growth, zones, etc., from adolescence to maturity, as well as in the number of ribs and the hinge characters, they are identical.

Family LUCINIDÆ.

Genus **LUCINA** Bruguiere.

13. Lucina bella Conrad.

One good example, beach; (Mus. No. 122112) also valves; abundant.

The first named from Chatham Island. Abundant on Hood Island; two left and one right valve and one perfect fresh specimen from Indefatigable Island. I am inclined to regard Carpenter's *L. pectinata* Maz. catalogue sp., 142, as a varietal aspect of this species. The *fibula* of Wimmer's list is probably this species. Carpenter, in Brit. Assn. Report 1863, says "Conrad's *bella* may be=*pectinata*."

Family CHAMIDÆ.

Genus CHAMA Bruguiere.

14. Chama echinata Brod.

Valves, beach.

Indefatigable and James islands.

Five odd valves, juniors from the former and one probably of this species from the latter island.

15. Chama frondosa Brod.

Valves, beach.

Several odd valves, generally in poor condition from James and two from Hood Island. This species is common at many places on the main land of South America; it is a variable form, and the more northerly, *C. spinosa* Brod., may be nothing but a variety of this. Reeve has credited other species to the Galapagos, viz., *spinosa*, *Janus*, and *imbricata*, the value of which it is not easy to determine; it is quite probable that too many species have been made. Also dredged off the coast of Lower California in 9½ fathoms.

Family CARDIIDÆ.

Genus CARDIUM Linné.

16. Cardium consors Brod.

One left valve, beach.

James Island.

Family VENERIDÆ.

Genus CHIONE Megerle.

17. Chione multicostata Sby.

Valves, beach.

James Island.

18. Chione compta Brod.

Three left valves, beach.

Indefatigable Island.

19. Chione undatella Sby.

Valves, beach.

James Island.

Two right and four left valves of what may be regarded as this species; the group to which it belongs is exceedingly numerous in individuals, and many species have apparently been made on simple varietal differences. Neither Carpenter's nor Wimmer's list credit any species of *Chione* to the Galapagos islands. The *Albatross* shells agree more nearly with the northerly *undatella* than with the geographically related forms from the mainland of South America.

Subfamily TAPESINÆ.

Genus **TAPES** Megerle.

20. **Tapes grata** Say.

Five valves; beach (Mus. No. 102457).

Indefatigable Island.

This species, which includes in its synonomy *Venus discors* Sby., extends from Lower California, southerly to the Gulf of California, Central America and Panama to Ecuador; it runs pretty close to the west South American *T. antiqua* King, in certain features.

Family TELLINIDÆ.

Genus **Lutricola** Blainville.

21. **Lutricola excavata** Sby.

? = *Lutricola alta* Conr.

One right valve, dead; beach.

Indefatigable Island.

Dr. Jones collected this (one valve) at Chatham Island, also at Payta. on the main land.

Class GASTROPODA.

Family BULLIDÆ.

Genus **BULLA** Linne.

22. **Bulla punctulata** A. Ad.

Abundant on the beaches.

Hood and indefatigable islands.

Dr. Jones found it common at Chatham Island as well as at various places on the main land of South America. *B. aspersa* A. Ad. is probably a synonym; it is very close to *B. adamsi* Menke of the Gulf of California.

Family BULIMULIDÆ.

Genus **BULIMULUS** Leach.

Subgenus **NÆSIOTUS** Albers.

23. **Bulimulus nux**, Brod., 1832.

The typical form was described by Broderip in the Pro. Zoöl. Soc. London, p. 125, and figured by Sowerby in his Conchological Illustrations 37 and 37*; the examples before me are from the same island as Broderip's type. Reeve's figure in the Conch. Iconica, 150, is misleading in this, that while it faithfully represents a not uncommon facies, it is not

a facsimile of the type as figured by Sowerby, and again it has more the appearance of a *Partula* than the characteristic aspect of *nux*.

Specimens closely agreeing with Reeve's figure* are in the National collection (Mus. No. 104822); they were presented by the late Dr. Lea, who received them, as well as other Galapagos species, directly from Mr. Cuming, and were no doubt a part of the original lot, collected at these islands by Cuming himself.

B. nux is an exceedingly variable form, and exhibits so many aspects of variation, that the most conservative conchologist might easily be led into species-making, even with an abundance of individuals before him, for this is one of those protean forms, like, for instance, *Patula strigosa–Cooperi–Haydeni–Hemphillii–Idahoensis*, etc., belonging to the Central province of the United States,† that can not be properly exemplified or understood by a few examples, nor even by a hundred specimens. In *B. nux*, some individuals are ventricose, others rather slender; in some the columella is straight or subarcuate, in others more or less twisted, or more properly distorted. Often the callus on the body whorl is heavy or thick, and connecting, forming a peristome; occasional individuals exhibit a tuberculoid thickening of the parietal callus on its edge. In some instances the shells are thin and almost translucent, others again, and more frequently, are opaque and solid. The sculpture varies from simple longitudinal incremental striæ more or less conspicuous, that is to say, fine or coarse, to examples with transversely or spirally incised grooving. Where these two aspects of sculpture are present in the same individual, a more or less distinct rectangular roughening is the result. Frequently the prevailing color is whitish or dingy white, in others dull purplish brown; many intermediate shades of these colors occur, and banded examples are not uncommon; in these the bands are sometimes conspicuous and striking and point towards a possible if not probable greater color-divergence, combined with slenderness of form, suggesting Forbes' *achatinellinus*.

Taking into consideration the different expressions of variation, *i. e.*, form, sculpture, color, and general proportions, *nux*‡ exhibits the greatest versatility; the extent of variability illustrated in the numerous examples, about two hundred before me, warrants the assumption that ten times the number would furnish many other facies, if not extremes of variation. I have above called attention to the discrepancies, between the figures of Sowerby and Reeve. In all cases where the various Galapagos species described by Broderip and Sowerby are referred to, the latter's figures must be regarded as authoritative, and be recognized as the standard type. Reeve's figures are frequently, if not usually, not a facsimile of the original,

* It is generally understood that Reeve's great work is in the main, based upon, and illustrates the Cuming collection.

† Binney's Manual Am. Land Shells, p. 163.

‡ *B. nux* occurs on three of the islands, viz, Charles, Chatham, and Albemarle.

but a figure of what in common parlance is called a "finer specimen" than the individual that was first described. It will at once be perceived that this practice must often lead to confusion. There are also discrepancies between the text and the numbering of the figures of the Galapagos Bulimi.

Reeve's figure "121 *eschariferus*" represents *rugulosus*, and his "135 *Jacobi*" probably applies to a bandless variety of *unifasciatus*.

To resume the consideration of the specific and varietal sequence and relationship of *nux*, as referred to and figured by authors, in comparison with the material before me, we have first—

Bulimulus nux Brod., Sby. Conch. Ill., figs. 37 and 37*.

*

Typical, numerous examples (Mus. No. 118568). Charles Island.

Color purplish-black or dark reddish-purple; apex dark; the following one or two whorls light colored, or whitish; figure 37 shows inconspicuous dark bands on the body whorl. In a large number of specimens it will be seen that these run gradually into ashen gray, and again into pale ashen-blue.

* *

B. nux, banded variety=**B. ustulatus** Reeve non Sby.

Four examples (Mus. No. 118569).

Vide Reeve's Monog. Bulimus, Conch. Icon., fig. 130, not Sowerby's Conch. Ills., fig. 42. Reibisch's figure 5, of "*ustulatus* Sby.," represents banded example of *nux;* it is intermediate in form between the above specimens (No. 118569), and the slenderer form to which Sowerby gave the name.

* * *

B. nux, variety with intercised sculpture.

Charles Island; numerous (Mus. No. 118570).

Purplish-brown to rufous-white; surface sculptured by revolving incised lines. Mr. W. G. Binney's "*Arionta intercisa*, a species of the California region, from San Clemente Island and Santa Cruz Island," in the Santa Barbara channel and Dr. Newcomb's "*A. Ayresiana*," another island species from the same region occurring on Santa Cruz, San Miguel and Santa Rosa islands, are pertinent illustrations of the sculpture exhibited by the above variety of *nux*.

I have before called attention to the relationship of the character of sculpture above mentioned to the environment. It will be observed that it is present in a greater or less degree in forms that inhabit saline, arid, sandy and wind-swept stations. The *Bulimi* of the Gulf of California region, of the *pallidior*, *regetus*, *Xantusi* group, exhibit it frequently; I have in mind *B. pallidior* from Carmen Island in the

Gulf, where the saline, sterile, and sandy elements prevail. Occasional examples of several species of the mainland forms of *Arionta* also furnish illustrations. In the sculpture of the South American *Bulimi* we find this character modified and carried to extreme elaboration until the shagreened surface is attained as in the Peruvian *B. proteus* and *B. mutabilis* (from Santos "under stones"). It will readily be seen that a form whose area of distribution includes subareas, where the environmental factors are varied to the extent of opposite or nearly opposite, as well as intermediate conditions, would exhibit extreme as well as a multitude of intermediate and what may be regarded as connecting facies or characters.

* * * *

B. nux Brod., Sby., ventricose variety = Reeve's type.

Several examples, Charles Island (Nos. 104822, 104963, and 122856).

This is the Reeve type of *nux*, a more ventricose, much larger, and freer growing form than the typical and original *nux* of Broderip. The color, etc., quoting Reeve, is "olive-brown stained with rusty red; the aperture is frequently compressed at the sides so as to give a square aspect." Some examples hint, in the matter of color, at dark *café-au-lait*. The color is sometimes a dark reddish-brown; of No. 104822 there are three specimens; No. 104963, two; these are rather globose, and coarsely sculptured; of 122856, there are five examples, all in good condition.

It is apparently an intercised aspect of this ventricose variety (*i. e.*, Reeve's type of *nux*) that has received the names of *asperatus* from Albers, and *incrassatus* from Pfeiffer (Mus. No. 23277). Reibisch gives a figure of Pfeiffer's species in plate 1, 4*a*, and adds a varietal name to the same of *sulcatus*, figs. 4*b* and 4*c*; while his figure 4*d* is given as *incrassatus* variety=*nuciformis* Petit, which is probably correct. Reibisch's figure 3, pl. 1, of *asperatus* Albers, indicates the propriety of its connection with the above.

* * * * * *

B. nux, elongated variety.

Charles Island; several examples (Mus. Nos. 118573, 122855, and 23277).

This is an elongated form of *nux*, sometimes strongly longitudinally ribbed, and probably includes *verrucosus* Pfr., as a variety. Nos. 118573, two examples, point toward B. *rugulosus*. Some forty or fifty examples in addition to the foregoing numbers, are in the National collection.

* * * * * * *

B. nux, variety with distorted mouth.

Charles Island; several (Mus. No. 118571). Parietal callus produced, forming a continuous peristome. Columella distorted or twisted.

The peculiar development of callus, and distorted aperture caused thereby, are probably due to the deposition of shelly matter, limey mucus or lymph, at the time of hibernation, when the animal has attached itself to the twig or stalk of the plant which is to be its resting place for its season of inactivity. The stalk or twig, being round or roundish, and the mouth of the shell or aperture not fitting closely to the inequalities of the surface, in order to exclude the air, a deposit is made, and a filling in of the chinks or closing of the gaps ensues, and perfect adhesion is secured as well as complete exclusion of the atmosphere. Where, in other instances, the peculiarity referred to is less conspicuous, the adhesion during hibernation has been to some object of a different shape, as perhaps, to the surface of a stalk of larger proportions, where the exact spot of adhesion was more nearly in plane with the aperture; in such a case the gap or discrepancy between the edge of the aperture and the surface adhered to, would require but a slight deposit in order to close it or, in other words, the character of the surface of the object to which the individual adheres at the time of hibernation, practically molds and shapes the peristome or edge of the aperture, the callus conforming to the inequalities of the surface.

* * * * * * *

B. nux, variety with crenulated suture.

Charles Island; one example (Mus. No. 122002).

The crenulation of the suture, attributable to the butting up of the incremental lines against the base of the preceding whorl, during the process of growth, a not uncommon character, and an exceedingly conspicuous feature in many of the South American Bulimi of the west coast.

* * * * * * * * *

B. nux, variety with sutural nodes.

Chatham Island; one example (Mus. No. 122003).

This form properly follows the preceding; it has a slightly crenulated suture in the specimen before me; and, as well as others that I have seen, is dark colored and has a sutural girdle of more or less conspicuous equidistant nodes. These sculptural characters occur doubtless quite independent of coloration. *B. nuciformis* Petit, is referable to this variety.

* * * * * * * * * *

B. nux, varieties intermediate.

I also include in the general synonymy of *nux*, *nucula* Pfr., *invalidus* Reib., and *venustus* Reib; the latter is apparently a dwarfed form. These species of Reibisch's are numbered in pl. I, figs. 6 and 7. His *Wolfi* is from Indefatigable Island, upon which *B. nux* has not yet

been detected, else I should regard that also as an aspect of *nux*, belonging to the variety represented in the National collection by No. 118571. Of the protean *nux*, it will be noticed upon the examination of Reibisch's list that he had only a few imperfect examples. Of what value to the student is such limited material?

24. **Bulimulus Jacobi** Sby.

Chatham Island; several examples; (Mus. No. 122005). Sowerby figures (Conch. Ill. 45,) both banded and bandless specimens. The above number includes shells that are obscurely banded (No. 122117 of the Museum series), and others that are distinctly banded. See previous comments (under No. 23) on Reeve's figure of *Jacobi*.

25. **Bulimulus rugulosus** Sby., not **rugulosus** Rve.

Charles Island; abundant (Mus. Nos. 122000, 122001).

This form is apparently nearly as numerous as *nux*. Reibisch refers it to Chatham and does not credit it to Charles Island. On the former he says "it is common on bushes, on the cliffs and under stones, at an elevation of from 300 to 600 feet; this is the prevailing form on Chatham, the same as *nux* is on Charles."

Ancey* has named two varieties of *rugulosus*, namely *infuscata* and *planospira*, both from Chatham Island examples.

In one example (No. 122001) we have an approach to *sculpturatus* Pfr.

26. **Bulimulus eschariferus** Sby., non Reeve.

Chatham Island, several examples (Mus. No. 422006).

It was on this island that Darwin collected his specimens; the Petrel-Cookson examples were detected on Charles Island. Of these, Mr. E. A. Smith says: "The Charles Island shells are considerably larger than those from the above locality [Chatham Island], and also coarser in sculpture, some of them displaying spiral granose or rugose striation, as in *B. rugulosus* Sby., from the same islands, and, indeed, they appear to be an intermediate variety or connecting link between the two species, both as regards size and sculpture."

Ancey† has named two varietal aspects of the foregoing, *bizonalis* and *subconoidalis*.

27. **Bulimulus (Pleuropyrgus) chemnitzioides** Forbes.

Chatham Island (Mus. No. 122004).

Several examples of this interesting form, upon which Von Martens‡ based his genus *Pleuropyrgus*, were detected at Chatham Island. It was here that Forbes's type was obtained; it is the only species in

*Bull. Soc. Malac. France. Juillet, 1887, pp. 293-299.

†Id.

‡Albers die Heliceen, 2d ed., Leipzig, 1860, p. 221.

Von Martens' genus thus far described. The National collection contains, in addition to the above, two examples (Nos. 122014 and 102549), collected by Dr. Habel several years ago, presumably at this island, though not definitely stated. Reibisch reports it from Chatham only, in the Wolf collection; three examples, abundant on rocks and under stones, with *Bul. rugulosus* at an elevation of from 300 to 600 feet. This species is "27" of the Reibisch-Wolf list. His "28" *B.* (*Pleuropyrgus*) *lima*, described from two examples, one of these possibly a junior, is probably identical with *chemnitzioides*.

28. Bulimulus (Pleuropyrgus) Habeli Stearns.

Plate LI, figure 1.

Nautilus, January, 1892, Dall.* Also described by the author in the Nautilus, December, 1892.

= *B.* (*Pleuropyrgus*) *terebra* Reibisch.†

Chatham Island (Mus. No. 122119).

Two specimens were collected at this island April 4, 1888. The National collection contains two other examples (No. 122015), detected by Dr. Simeon Habel, at some one of the islands, several years ago, presumably at Chatham, which is the only island of the group where the *Pyrgus* type of bulimoids has been found. The *Albatross* shells are in perfect condition, the Habel specimens somewhat rubbed. One of the latter is of a pale, dull, reddish tint throughout the greater part of the shell, lighter on the upper part of the whorls following the suture, with a narrow whitish band on the basal whorl, and the columella white or whitish. The other of the Habel examples is white throughout; the lower three or four whorls preceding the basal, are rather faintly banded with pale ferruginous red, which alternate with whitish bands above and below on the basal whorl. The Habel specimens being somewhat rubbed, the ribbing is less conspicuous than in the *Albatross* examples, and the whitish surface glazing of the *Albatross* specimens obscures to a considerable degree the color beneath, as seen in Dr. Habel's shells. A fuller description than that given by Mr. Dall was published by me in The Nautilus, December, 1892, together with preliminary diagnoses of other species from the Galapagos and elsewhere. The portion relating to the above is here repeated: "Shell slender, elongated, thin, smooth, and shiny, slightly umbilicated, with thirteen to fourteen gradually increasing whorls; whorls slightly convex and longitudinally obtusely plicated; suture distinct; aperture ovate and slightly reflected at the base of the columella. Color ashen white, slightly rufous, with hints of a narrow reddish band beneath the surface glaze.

"Dimensions (of largest example): Long. 17.5, diameter, 3.5 millimeters.

* "On some types new to the fauna of the Galapagos Islands," by W. H. Dall.

† Die Concholiogische Fauna der Galapagos-Inseln, von Paul Reibisch, Ges. Isis in Dresden, 1892. Abh. 3, 20 pp., 2 plates.

"This form is much more slender than *P. chemnitzioides* Fbs., which is well represented by the figs. 6*a*, 6*b*, Pl. IX, Proc. Zoöl. Soc. London, 1850. Aside from the differences in color and sculpture, the surface of Forbes's species is dull in fresh, unrubbed, perfect specimens; the ribs in the latter species are comparatively sharp, threadlike, regular, and somewhat distant, the interspaces being perceptibly wider than the ribs are thick."

Again borrowing from Reibisch, it is seen that the foregoing occurs at an elevation of from 900 to 2,000 feet in the wooded region, on mossy rocks and under stones, and he quotes Wolf's notes, and says that it is abundant, though it appears that Reibisch had only four examples, of which hardly one was well preserved.

The various species made by Reibisch are based, it would seem, upon a very uncertain foundation, the number of individuals, in most cases being altogether too limited, the extraordinary variability of the Galapagos land shells being considered, and the few examples upon which in nearly every instance his diagnoses rest, were generally in poor condition.

Family SUCCINIDÆ.

Genus **SUCCINEA** Draparnaud.

29. **Succinea Bettii** Smith, var. = **S. Wolfi** Reib., var.

Chatham Island, one example (Mus. No. 122133).

This shell is a narrow, delicate variety of the species described by Mr. Smith, whose specimens were from Charles Island (Petrel-Cookson collection). This solitary *Albatross* example agrees with Reibisch's Fig. 12*b* in Pl. II of his paper.

Family ONCHIDIIDÆ.

Genus **ONCHIDIUM** Cuvier.

30. **Onchidium Lesliei** Stearns.

Preliminary description in "The Nautilus," December, 1892.

Plate LI, figures 2, 3.

Between tide marks, living.

Charles Island, April 8, one example (Mus. No. 122519); Albemarle Island, April 10, 1888, two specimens (Mus. No. 122520).

Form rounded ovate, nearly as broad as long. Dorsum coriaceous, nearly black, shiny, closely irregularly reticulated with finely incised lineation, and otherwise characterized by somewhat distant, rather flatly rounded papillæ. Under side dingy, yellowish white; margin of mantle wide, nearly smooth; edge of same simple. Anal opening posterior near edge of mantle and somewhat produced. Respiratory orifice smaller, in median line with and in front of anus. Sexual orifice anterior, on the right side under the edge of the large oral hood or collar. Labial palpi thin, largely expanded. Dimensions: Length, 37.5;

breadth, 31.5 millimeters. These proportions vary slightly in different individuals.

Genus **ONCHIDELLA** Gray.

31. Onchidella Steindachneri Semper.

Plate LI, figures 4, 5.

Living examples, between tide marks.

Charles Island, April 8, six specimens (Mus. No. 122518); Albemarle Island, April 10, 1888, one example (Mus. No. 122517).

A well-marked species; edge of mantle prettily fringed on the under side with rather regularly placed trifoliate processes. Dorsum entirely covered with closely set, rounded, granular papillæ, which also cover the surface of the wide mantle margin beneath, up to the edge of the creeping disk. Color dark grayish or smoky black above; dingy whitish on the under side. Anal orifice posterior, central just behind the end of the creeping disk? Respiratory orifice on the right side near the vent. Sexual orifice anterior near the tentacle or oral appendage, under the edge, on the right side. Length about 20, breadth about 17 millimeters. These proportions vary somewhat in different specimens. Some allowance must be made for the contraction caused by the alcohol in both the above and *O. Lesliei*.

Family SIPHONARIIDÆ.

Genus **SIPHONARIA** Sby.

Subgenus **WILLIAMIA** Monterosato.

32. Siphonaria (Williamia) peltoides Dall.

Beach shells.

Hood Island, two examples in fair condition (Mus. No. 102365); previously detected in the Galapagos by Dr. Habel (Mus. No. 60416), at which of the islands not stated. Dall* gives the range of its distribution northerly as Monterey; it has since been detected near Crescent City, Cal., which adds about 370 miles to its northerly range.

Family CONIDÆ.

Genus **CONUS** Linné.

33. Conus brunneus (Gray) Wood.

+ *C. diademus* Sby.
+ *C. tiaratus* Brod.

Numerous; beach shells.

Hood, Indefatigable, and James islands each furnished many examples of the typical form of *brunneus*.

An exceedingly variable species in size, color, and sculpture.

The uniformly brown-colored specimens = *C. diademus* Sby. The sharply sculptured and generally dark-colored individuals (Sow.,

*Am. Jour. Conch., Vol. VI, 1870.

Conch., Ill., fig. 10) are the *tiaratus* Brod. described by the author from Galapagos examples. Pale-colored specimens with a facies intermediate with these have been credited to the Indo-Pacific species *miliaris*, or rather this last has been credited to the Galapagos Islands through the general and often quite close resemblance of individuals from these widely separated regions. The variety of *brunneus* resembling *miliaris* was obtained at both Hood and Duncan islands. Another Indo-Pacific cone, *C. minimus* auct., has been wrongly referred to these islands, the exceeding variableness of *C. brunneus* and the erroneous determinations of authors having brought about this confusion. Thus Reeve says, in his Monograph of the cones, "there can be no doubt of Mr. Broderip's *C. tiaratus* being a variety of *minimus;* they exhibit too many characters in common to allow of their being separated." Cuming collected the Broderip form at the "Galapagos Islands, found in pools on the sands." Subsequently at the end of his Monograph, Reeve changed his mind and admitted Broderip's *tiaratus* as valid, but failed to observe its relationship to *brunneus.* Tryon also fell into the error of including *tiaratus* in the synonymy of *miliaris*, and in this way crediting the latter to the Galapagos Islands. Reeve also (Monograph of the Cones, Pl. XLI) adds to the confusion by fig. 224, "*C. varius* B., Galapagos Cuming," which figure simply presents a variety of *brunneus* and corresponds to two examples collected by Dr. Jones at Manta, Ecuador. Cuming found this shell in clefts of the rocks at low water. It has been monographed with *varius*, an Indo-Pacific species, as "*pulchellus* Sby., non-Swainson, and *interruptus* Wood."

A common aspect of *C. brunneus* is of a uniform sienna-yellow with a faint median band and purplish at the base of the columella. The sculpture, as before intimated, varies considerably in sharpness, and this applies as well to the granules on the main whorl as to the coronation of the spire.

The importance and advantage of a large series of a species such as that of *C. brunneus* in the national collection are obvious when questions of identity and distribution are involved, as in the foregoing instance.

The synonymy also through error includes, as my remarks show, *miliaris*, *minimus*, and *varius* B., all Indo-Pacific forms. While many forms of a decided Indo-Pacific character do occur on the west coast of North America, I have as yet failed to detect a single Galapagos species that does not exhibit as close or closer relationship to characteristic West American mainland forms.

34. Conus lucidus Mawe.

=*C. reticulatus* Sby.

Not common; beach.

Hood and James islands.

Dr. Jones collected one example at Chatham Island.

35. **Conus pyriformis** Rve.

A single example (Mus. No. 102342).
Hood Island.

36. **Conus nux** Brod.

Beach shells.
Hood (102345) and James islands (102271).

Exceedingly close to the Indo-Pacific species *Ceylonensis* Hwass., which latter includes according to Tryon the synonyms *pusillus* Gould, *acutus* Sow., *pusillus* (Chemn.) auct., *tenuisulcatus* Sow., *sponsalis* Chemn., *nanus* Brod., to all of which, excepting Gould's, Tryon gives a varietal position. Tryon includes the west coast shell in the synonymy of *Ceylonensis*, but whatever may be the opinion of others on this point Broderip's name may conveniently be retained for the West American shell. Found at Chatham Island by Dr. Jones.

37. **Conus gladiator** Brod.

One example, beach, (102273.)
James Island.

Mr. Tryon comments on the closeness of this form to *brunneus*. I have at various times possessed and handled a large number of specimens, but have never been impressed by any such resemblance.

38. **Conus Fergusoni**. Sow.

Several specimens, beach.
James Island (No. 102270); Indefatigable Island No. 102450).

This rare species seems to have its home in the Galapagos islands. The original example, 5¾ inches in length, was said to have been collected at Panama. Some seven or eight specimens were obtained by the *Albatross*, four of them at Indefatigable Island. The largest of these was 4⅝ and the smallest 2¾ inches long. One of them was quite fresh, with epidermis intact. Notwithstanding its large size, it is quite unattractive, being a coarse white species without the slightest ornamentation.

The Galapagos islands, or rather certain of them, appear to be the specific center of a few marine forms, and a few other species here attain, in the matter of size and solidity, a remarkable development. Among the Cones *C. Fergusoni*, exceedingly rare on the mainland and so seldom met with in collections, is not infrequent on James and Indefatigable islands; so with *Conus purpurascens* and the variety of the same known as *C. regalitatus*, which are found at several of the islands. The interesting and variable *C. brunneus*, with its characteristic yet extreme varieties, has its metropolis in the Galapagos group. So also with *Murex* (*Phyllonotus*) *princeps*, *Purpura melo*, *P. planospira*, *P. patula* and its close relative *P. columellaris*. *Cassis tenuis* here attains a vigorous growth and frequently an extraordinary size and solidity; *Cypræa nigropunctata* is common, elsewhere exceedingly rare, and so with many other less conspicuous forms.

39. Conus purpurascens Brod.

+*C. regalitatus* Sow.

Common; principally worn beach shells.

Hood, James, Indefatigable, and Charles islands.

Tryon, following previous writers, assigns to *regalitatus* a varietal position, but examples that are intermediate in coloration are exceedingly numerous. Hence no doubt the following synonymy which includes *C. neglectus* A. Ad., based upon a young example; *C. luzonicus* Sow, non Hwass., and *C. comptus* Gould; and perhaps *C. achatinus* Mke., non. Chemn, as the variety *regalitatus*. From James and Hood islands the examples are numerous and principally of the typical *purpurascens* coloration, etc. (Nos. 102276 and 192240); specimens of the *regalitatus* var. (No. 102277) were obtained at James Island. One of each from Indefatigable (Nos. 102460 and 102461); and one beach shell of the varietal form, from Charles Island (102312). Tryon gives the distribution as extending from Panama to Mazatlan, but my paper on Dr. Jones' shells carries the species as far south as Payta in Peru, and unpublished notes on a large collection made several years ago by Mr. W. J. Fisher adds considerably to its northerly range in the Gulf of California region, namely, at San Josef Island, Port Escondido, Los Animas Bay, Angeles Bay, as well as the group of islands known as Tres Marias.

Family PLEUROTOMIDÆ.

Genus MANGILIA Risso.

Subgenus CYTHARA Schumacher.

40. Cythara densistriata Cpr.

Two examples (No. 122125).
Chatham Island.

Subgenus DAPHNELLA Hinds.

41. Daphnella sp.

A single beach-worn example from Indefatigable Island, too much rubbed to admit of determination. Hinds described *D. casta* from the west coast of America; it may belong to that species.

Family OLIVIDÆ.

Genus OLIVELLA Swainson.

42. Olivella ? gracilis Gray.

One beach specimen (Mus. 122120).

Chatham Island.

The worn condition of this solitary example makes the foregoing determination somewhat doubtful.

The Olives, so common on the mainland and in the Gulf of Califor-

nia, seem to be of rare occurrence in the Galapagos Islands. Carpenter reports only one, *kaleontina*, in his Reeve list. Dr. Jones detected *O. peruviana*, one example, and the *Albatross* collectors were the first to collect an *Olivella*.

Family MARGINELLIDÆ.

Subgenus **PERSICULA** Schumacher.

43. Marginella (Persicula) imbricata Hinds.

One example beach; (Mus. No. 117969).

Indefatigable Island.

A single specimen, considerably rubbed, but agreeing in form with the perfect examples in the National collection.

44. Marginella (Persicula) phrygia Cpr.

One specimen, beach; (Mus. No. 117968).

Indefatigable Island.

The characteristic markings of this species are sufficiently distinct in the solitary specimen collected to make the above determination satisfactory. The National Museum has another example from the Galapagos (No. 56077), the particular island not specified, probably collected by Dr. Habel.

Family MITRIDÆ.

Genus **MITRA** Lamarck.

45. Mitra effusa Swains.

One fresh, perfect specimen (Mus. No. 102391).

James Island.

The distribution heretofore given as "Guacomayo, Central America, Galapagos Islands," must be extended northerly to the Gulf of California. Fisher collected it in Mulege Bay, and several years ago the late Dr. W. M. Gabb detected it somewhere along the Gulf coast of Lower California.

Genus **STRIGATELLA** Swainson.

46. Strigatella tristis Brod.

Beach shells not uncommon.

Hood, Duncan, and James islands.

Several examples from Hood (No. 102381), one shell from James Island, and a fresh specimen from Duncan Island (Mus. No. 102315). The occurrence of this species in the Galapagos group is corroborated by Dr. Habel's specimens (Mus. Nos. 56133, 56337), as well as by other collectors. Tryon, following Carpenter, gives the northerly distribution as Mazatlan, but it is found at other and more northerly localities

in the Gulf of California, etc., where Fisher collected it in Mulege and also in Los Animas bays on the easterly shore of Lower California respectively, about 200 to 325 miles farther to the north.

Family FASCIOLARIIDÆ.

Genus FASCIOLARIA Lamarck.

47. Fasciolaria princeps Sow.

Broken shell and fragments.

James and Indefatigable islands.

Cuming collected this species on the coast of Peru, the most southerly point reported; not before detected at the Galapagos Islands.

Genus LATIRUS Montfort.

48. Latirus varicosus Rve.

Beach specimen.

James Island.

49. Latirus tuberculatus Sby.

Common on the beaches.

Hood Island (1); James Island (3); Indefatigable (3); Duncan Island, numerous fresh examples (Mus. No. 102314).

Family BUCCINIDÆ.

Genus PISANIA Bivona.

Subgenus TRITONIDEA Swainson.

50. Tritonidea sanguinolenta Duclos.

= *T. hæmastoma* Gray.

Beach shells, in various conditions.

Hood Island, not uncommon (Mus. No. 102379); James Island, frequent, two fresh specimens; Duncan Island, one beach shell; Charles and Indefatigable islands, beach shells and fragments. The inclusion of *Janelii*, Val.,* in the synonomy of *hæmastoma* by Carpenter and others is an error, as *Janelii* is a markedly different form.

Genus ENGINA Gray.

51. Engina carbonaria Reeve.

Beach shells, in various conditions.

Hood Islands, numerous (Mus. No. 102363); James and Duncan islands (Mus. No. 102319), one each.

52. Engina carbonaria Reeve., var. = crocostoma Reeve. + forticostata Reeve.

Beach shells.

Hood Island (Mus. No. 102364). Tryon included *crocostoma* and *forticostata*, both of Reeve, in the synonomy of *carbonaria*, and I am in-

* *Buccinum Janelii* Val., Voy. Venus, Moll., 1846.

clined to think he was right. *E. crocostoma*, as I see it, is a yellow-mouthed variety of *carbonaria*. The typical *carbonaria* has a bluish-white mouth.

Family NASSIDÆ.

Genus **NASSA** Lamarck.

53. **Nassa nodicincta** A. Adams.

Beach shells.

Indefatigable Island (Mus. No. 122113); Chatham Island (No. 122111; one at each place. This is rather a rare form. Previously reported from the Galapagos by Cuming. Not figured in Tryon's Monograph or elsewhere, so far as I have been able to learn.

Family COLUMBELLIDÆ.

Genus **COLUMBELLA** Lamarck.

54. **Columbella castanea** Sow.

Beach shells, in good condition.

Hood Island. four specimens (Mus. No. 102374).

55. **Columbella Paytensis** Lesson.

= *C. spurca* Sow.

Beach specimens.

Hood Island (Mus. No. 102373); Indefatigable Island (Mus. No. 102468). The example from Hood is hardly characteristic, yet it is nearer *paytensis* than to *castanea*. Abundant at Payta (Jones's collection).

56. **Columbella hæmastoma** Sby.

Not uncommon, beaches.

James Island, five. Hood, common. Indefatigable, two specimens, one fresh (Mus. Nos. 102460, 102372). Occurs also on the coast of Ecuador and in the Gulf of California.

57. **Columbella fuscata** Sby.

Beach shells; many fresh and in good condition.

Indefatigable and Hood islands, common (Mus. Nos. 102467, 102371); Chatham, one example (No. 122118); and James Island, two fresh specimens. Dr. Jones collected this species at Payta, Peru, and at Manta, Ecuador. Common in the Gulf of California.

Subgenus **NITIDELLA** Swainson.

58. **Nitidella incerta** Stearns.

Plate LI, figure 6.

(Preliminary description in "The Nautilus," December, 1892.)

One example, beach, dead; one perfect.

Indefatigable Island (Mus. No. 122012). Also (island not stated) Habel collection (Mus. No. 122013).

Shell small, rather solid, acutely ovate, spire elevated, pointed, whorls six to seven, moderately convex, with inconspicuous revolving grooves, more distinct on the lower part of the body whorl; upper whorls delicately sculptured with close-set, rounded, longitudinal ribs. Apex obtuse. Aperture nearly half the length of the shell. Outer lip somewhat thickened, with five to seven denticles on the inner side. Columella, with a single rather prominent plait or tubercle, just below the middle. Surface colored by five to six brownish red bands, alternating with as many white ones, on the body whorl.

Dimensions: Length, 6.02; length of aperture, 3; breadth, 2.75 millimeters.

The above description is based on a single fresh perfect specimen in the Habel lot (122013); the others are so much rubbed as to be of little diagnostic value. All show the tubercle on the columella. It is not unlikely that in a number of fresh specimens considerable color variation would be exhibited. The specimen described is beautifully and conspicuously banded or striped. The above is nearer to Carpenter's *Nitidella millepunctata* than to any other west coast form with which I am familiar. In comparison with the most perfect adult of the latter, from Cape St. Lucas (Mus. No. 4147), certain similarities and differences are perceptible. The interior crenulation of the outer lip, the longitudinal plication of the upper whorls, and the sculpture striation of the lower part of the basal whorl are nearly or quite alike in both. The differences are seen in the more elongated form of *millepunctata*, the greater convexity of the whorls, the more pronounced sutural definition, and the strong tubercle on the columella. The color marking of *millepunctata* is indicated by the specific name, and the general tone of the surface is yellowish.

This may possibly be "24 ? sp." of Wimmer's list from Bindloe Island, which he refers to *Amycla* and compares with *avara* Say. It is often not easy to determine to which of the groups of the *Columbellidæ* some of the forms should be assigned.

Family MURICIDÆ.

Subfamily MURICINÆ.

Genus MUREX Linné.

Subgenus PHYLLONOTUS Swainson.

59. Murex (Phyllonotus) princeps Brod.

Beach shells in various conditions.

James and Charles islands, common; also less numerous on Indefatigable Island. Frequently of large size and often quite solid and heavy.

Genus **TROPHON** Montfort.

60. **Trophon ? xanthostoma** Brod.

=T. *Peruvianus* Lesson.

One beach shell, junior, in good condition. Hood Island. (Mus. No. 102351).

Subfamily PURPURINÆ.

Genus **PURPURA** Bruguiere.

61. **Purpura patula** Linné.

Common on the beaches, etc.

James, Indefatigable, and Hood islands. Several fresh specimens from the first place (Mus. No. 102279), and numerous dead shells from the other islands. Also at Chatham Island, in Jones's collection.

Section PURPURELLA Dall.

62. **Purpura (Purpurella) columellaris**, Lamarck.

Common along the shores, etc.

Hood, James, Chatham, Charles, Duncan, and Indefatigable islands; quite large and heavy shells from the latter (Mus. Nos. 102376, 102311, 102318, 102282, and 122113). From Hood one solid specimen measured 3 inches, and the smallest adult only thirteen-sixteenths of an inch in length. The examples from James Island vary considerably in the elevation of the spire.

Section PLANITHAIS Bayle.

63. **Purpura (Planithais) planospira** Lam.

Beaches, abundant and frequently of large size.

Hood, Indefatigable, and James islands (Mus. No. 102377); quite numerous on the two last islands, where it often occurs with the surface burrowed by some form of *Pholad* or *Lithodomus*. This species appears to be rather insular in its distribution. It is abundant and fine at Socorro Island, one of the Revillagigedos group, which is situated in latitude 18° 35′ north, and longitude 111° west of Greenwich, distant from Mazatlan something over 300 miles, in a southwesterly direction, and about 240 miles south from Cape St. Lucas. The Galapagos examples are often exceedingly solid and heavy.

Section THALESSA H. & A. Ad.

64. **Purpura (Thalessa) melo** Duclos.

Beach shells, common.

James, Duncan, Hoods, and Indefatigable islands. Closely related to the Antillean *deltoidea*, and suggestive of a common ancestry. Dr. Jones collected the above at Chatham Island.

65. Purpura (Thalessa) callaoensis Gray.

= *Coralliophila callaoensis* Auct.

Fresh specimens, beach.

Charles Island, three examples (Mus. No. 102313). In Tryon's Manual the above is grouped with *Coralliophila*. Common at Manta, coast of Ecuador.

Genus MONOCERAS Lamarck.

(=ACANTHINA F. de Waldheim).

66. Monoceros grande Gray.

Beach specimens.

James and Indefatigable islands; apparently rare; the distribution of this species seems to be confined to the Galapagos group; the national collection contains a good example (No. 60719), probably collected by Dr. Habel; the particular island not stated.

Subfamily TÆNIOGLOSSA.

Family TRITONIIDÆ.

Genus TRITONIUM Cuvier.

Section COLUBRARIA Schumacher.

67. Tritonium (Colubraria) Sowerbyi Reeve.

The basal whorl, of what I regard as the above species, was obtained at Indefatigable Island (Mus. No. 117976). Reeve credits the above (6 fathoms sandy mud, Cuming), as well as a related form *T. reticulatus* to the Galapagos group. The fragment before me is in fair condition so far as color and sculpture go. While it evidently has general relations with *T. testaceus* Morch (=*distortus* and *obscurus*, Tryon pars.), it is much more finely sculptured and less rugged in its general facies than the latter; it also somewhat resembles *T. reticulatus* Blve., (=*intertextus* Rve.), but is a more solid shell than that species. Both *reticulatus* and *testaceus* are found in the Antillean-Caribbean region. As many marine species are common to the waters on both sides of Middle and South America, and many of the Tritons have an exceedingly wide geographical range, it would not be especially remarkable if either of the above were detected on the west side. Reeve has credited *recticulatus* to the Galapagos, but I am inclined to think that a small example of *Sowerbyi* is what that author had before him. The sculpture of the fragment agrees with the description which Reeve has given as characterizing *Sowerbyi*, and though the fragment is without the general color or markings of either *recticulatus* or *Sowerbyi*, in my judgment it should be assigned to the latter rather than described as new. In the Colubraria group of Tritons color is not a constant character, and many of the species, to my knowledge, are colorless or nearly destitute of color markings.

Section **SIMPULUM** Klein.

68. Tritonium (Simpulum) olearium Linné.

Beach, fragment.

Indefatigable Island. A part only of a specimen, but sufficiently large and in good enough condition, so that the determination was not difficult. Dr. Jones detected this species on the coast of South America, at Manta, in Ecuador; also at Payta, in Peru. The *Albatross* and Jones collections greatly extend the previously well-known wide distribution of this form. Its geographical range is seemingly world-wide within tropical and semitropical waters.

Family CASSIDIDÆ.

Genus **CASSIS** Lamarck.

Subgenus **CYPRÆCASSIS** Stutchbury.

69. Cassis (Cypræcassis) tenuis Gray. = *C. Massenæ* Kiener.

Common along the shores and the beaches.

James, Charles, Hood, and Indefatigable islands. The Galapagos group, if we may judge by number of individuals and the sturdy growth and size many of them exhibit, is the metropolis of this fine species. From Indefatigable the largest specimen measured 5¼ inches in length, with three to four conspicuous rows of nodules on the body whorl. An example somewhat larger from Hood Island, is about 5½ inches long, and nearly as heavy as an average individual of the Indo-Pacific *Cassis rufus* of same length. In Tryon's monograph of the *Cassididæ* this species is credited to the Galapagos only; it occurs however in the Gulf of California; the largest example from the Gulf region that I have seen is much smaller and less heavy than the maximum specimens from the Galapagos. A fine example from the Galapagos obtained by the late J. A. McNiel, measured nearly 6 inches in length.

Genus **ONISCIDIA** Swainson.

70. Oniscidia tuberculosa Rve.

Common on the beaches.

James, Hood, and Indefatigable islands. An abundant species at James Island where forty-six shells were obtained; less numerous at Indefatigable (Mus. Nos. 102463, 102370). Dr. Jones obtained it at Chatham Island.

Family CYPRÆIDÆ.

Genus **CYPRÆA** Linné.

71. Cypræa exanthema Linn., var. =**C. cervinetta** Kien

Beaches, not uncommon.

James and Indefatigable islands. This form has a wide distribution, from Payta, Peru, in the south to the Gulf of California and La Paz,

Lower California, in the north. The name *cervinetta* Kien, has quite generally been applied to the west coast shells, and it may be well for geographical reasons to so label them or as "*C. exanthema* var.=*C. cervinetta* Kien.," as above. They are one of the "pairs of analogues which inhabit both sides of the isthmus," of Darien, or Panama, as it is more commonly called. While the individuals of the two coasts are easily separable, there can be no doubt as to their ancestry. *C. cervus*, the habitat of which has been a matter of doubt, and therefore of discussion, is undoubtedly an east coast form, and may be regarded as a variety of *exanthema*. It is much more ventricose in proportion to its length, and as a rule, the spots are closer and more numerous than in *exanthema* proper. I have received first and last a great number of individuals of var. *cervinetta*, and have critically examined many more belonging to various persons, but have never met with the *cervus* form from the west side. The National Museum contains characteristic examples of *cervus* from Vera Cruz, collected by Dr. Strebel, in 1866.

Subgenus **LUPONIA** Gray.

72. Cypræa (Luponia) nigropunctata Gray.

Common on the beaches.

James, Hood, and Indefatigable islands (Mus. No. 102375). For the most part in poor condition. The Galapagos Islands are apparently the specific center or metropolis of this form. Dr. Jones solitary example from Manta, Ecuador, confirms the previous somewhat doubtful report of its occurrence on the coast of the mainland.

73. Cypræa (Luponia) albuginosa Mawe.

Beach shells.

James Island, one example. Previously credited to the Galàpagos in Wimmer's list.

Genus **TRIVIA** Gray.

74. Trivia Pacifica Gray.

Beach shells.

Hood Island, four beach shells but fresh and in good condition (Mus. No. 102362).

Family CERITHIOPSIDÆ.

Genus **CERITHIOPSIS** F. & H.

75. Cerithiopsis neglecta C. B. Adams.

Beach shells.

Indefatigable Island, two examples (Mus. No. 122128).

Family CERITHIIDÆ.

Genus CERITHIUM Bruguiere.

76. Cerithium maculosum Kiener.

+ C. *adustum* Kiener.
= C. *nebulosum* Sby.

Common on the beaches.

Duncan, James, and Indefatigable islands. Numerous specimens, some quite fresh and perfect were obtained; these include both; the smoother form is the *C. adustum* Sby. var., non Kiener, the latter author's figure and diagnosis not agreeing, else the wrong number is attached to the figure. At Chatham Island, Dr. Jones collected several examples.

Family MODULIDÆ.

Genus MODULUS Gray.

77. Modulus cerodes, A. Ad.

Beach shells.

Hood Island, two beach-worn specimens (Mus. No. 102354). Not heretofore reported from the Galapagos.

Family VERMETIDÆ.

Genus VERMETUS Morch.

Subgenus SERPULORBIS Sassi.

78. Serpulorbis squamigerus Cpr.

Beach shells, numerous.

Hood, James, and Indefatigable islands (Mus. No. 102341, 102350, 117966, 117967). From Hood Island, one example apparently varietal (No. 102350), rather flattened with pinched sides, resembling *V.* (*Aletes*) *centiquadrus* Val.

Subgenus ALETES Carpenter.

79. Aletes, species.

Beach, fragment.

Hood Island, too small and imperfect to warrant an attempt at determination.

Family LITTORINIDÆ.

Genus TECTARIUS Valenciennes.

80. Littorina (Tectarius) galapagiensis Stearns.

Plate LI, figure 7.

Preliminary description in "The Nautilus," December, 1892.

James Island; one example fresh and in good condition (Mus. No. 102509).

Shell small, rather solid, ovate conic, angulated in outline; five to

six and a half whorls; whorls covered with obtusely rounded and rather coarse nodules; of these the peripheral series is the strongest and the next preceding, somewhat less prominent, while the other girdles of nodes are still less conspicuous. The peripheral is closely followed by a parallel series just below, and the base is marked by succeeding rows of less prominence. The aperture is rounded-ovate and of a dark chocolate color; columella broad, somewhat excavated and produced below. Exterior dull chocolate-brown above, paler below, with still paler nodules.

Altitude, 7.50; latitude, 5 millimeters. Comparison with the Antillean and Indo-Pacific forms in the National collection indicates its non identity with any heretofore described.

Wimmer's list includes two species, namely (Hamus) *lemniscatus* Phil. and *trochoides* Gray, the first of the group reported as occurring here. The form herein described does not agree with either of the species catalogued by Wimmer; it is not so acutely conical as *trochoides* Gray, which Tryon includes in the synonymy of *nodulosus* Gmel., and the columella is broader and more produced at the base (posteriorly) than in *lemniscata* Phil., an Indo-Pacific form, regarded by Tryon as a synonym of *miliaris*. If Wimmer's determination is correct, which I am rather inclined to question, then three species of *Tectarius* are found in the Galapagos. Dr. Jones detected a single individual of this group at Manta, Ecuador, which I have listed with the Jones shells by the name of *Tectarius atyphus*, the first example of this genus from the West coast of the American continent. This is not referable to either of the species catalogued by Wimmer or to any others of the group, which is largely represented in the National collection.

Family RISSOIDÆ.

Genus RISSO Fréminville.

Subgenus ALVANIA Risso.

81. Alvania reticulata Cpr.

not *R. reticulata* Mont.,
= *R. Carpenteri* Weink., (Tryon).

Beach specimen in fair order.

Indefatigable Island, one example (Mus. No. 122127).

Described by Carpenter from Neeah Bay, Puget Sound specimens in the Ann. & Mag. Nat. Hist., Vol. XIV, 3d series, and agreeing with examples in the National Museum identified by Carpenter.

Wimmer records a species of *Alvania* without name; possibly either this or the following.

82. Alvania æquisculpta Cpr.

Beach example

Indefatigable Island (Mus. No. 122126). The single specimen collected by the *Albatross* was fortunately sufficiently perfect to admit of

identification. Named by Carpenter from Monterey, Cal., examples; collected by Mr. Harford and myself in 1867; now in the National Museum.

Genus **RISSOINA** Orbigny.

83. Rissoina fortis C. B. Adams.

Beach.

Hood Island, two shells (Mus. No. 102380). This species is in Wimmer's list.

Family CALYPTRÆIDÆ.

Genus **MITRULARIA** Schumacher.

84. Mitrularia cepacea Brod.

=*Calytræa cepacea* Brod., Auct.

Beach, rare.

Indefatigable Island, one specimen (No. 102462); Chatham Island, three good specimens (Mus. No. 122116). Dr. Jones collected a specimen of this form at Manta, Ecuador (No. 48402). Tryon includes the above in his synonymy of *equestris*. Wimmer's list contains *Calyptræa varia* Brod., which may be the same as I regard as *cepacea* or the following. The Museum has an example of this rare form from Acapulco (No. 60248) and one from Panama (No. 3668).

85. Mitrularia corrugata Brod.

=*Calyptræa corrugata* Brod., Auct.

Beach shells.

James Island one imperfect example, but in sufficiently good condition to show clearly the characteristics of this rare species (Mus. No. 102511). This species appears to be another addition to the Galapagos list; it occurs at Acapulco, though quite rare nearly everywhere along the coast (Nos. 60247 and 59298).

Genus **CRUCIBULUM** Schumacher.

86. Crucibulum imbricatum Brod.

Beach specimen.

James Island; a single example in poor condition. Not before reported from the Galapagos. This form ranges from Lower California in the north to Payta, Peru, where several examples some 2½ inches in diameter were obtained by Dr. Jones. The small Galapagos collection made by Dr. Jones at Chatham Island includes *C. spinosum* Sby., which seems to have escaped detection by the *Albatross* collectors. This latter ranges much farther to the north than *imbricatum*, namely, to Monterey, Cal.

Mr. Tryon, in his monograph of the genus *Crucibulum*, makes the various imbricated forms that have been described, synonyms of *scutellatum* Gray; those that are "finely radiately costulate or smooth" he includes under the *varietal* name of *quiriquina* Lesson. Certain West Indian species he consolidates under the *varietal* name of *auriculatum* (Chemn.) Auct., an Indo-Pacific form is made var. *violaceum* Carpenter, and the West American spinose forms he places under the varietal name of *tubiferum* Lesson. His subordination of groups and species is as follows:

C. scutellatum Gray.
= *C. imbricatum* Brod.
= *C. corrugatum* Carp.
= *C. rugosum* Lesson.
= *C. dentatum* Menke.
= *C. costatum* Menke.
= *C. Cumingii* Carp.
= *C. extinctorium* Sowb.
= *C. rude* Brod.
= *C. gemmacœa* Val.
= *C. pectinatum* Carp.
= *C. umbrella* Desh.
= *C. planata* Mörch.
= *C. concameratum* Reeve.
= *C. serratum* Brod.
The two latter presumably young shells.

Var. *quiriquina* Lesson.
= *C. trigonale* Ads. & Rve.
= *C. ferrugineum* Reeve.
= *C. lignaria* Brod.
= *C. tenue* Brod.
= *C. spectrum* Reeve.

Var. *auriculatum* (Chemn.), Auct., West Indian.
= *C. Cuvieri*? Desh.
= *C. planatum* Schum.
= *C. Caribbeense* Carp.

Var. *violaceum* Carp. Ceylon.

Var. *tubiferum* Lesson.
= *C. spinosum* Sowb.
= *C. cinereum* Reeve.
= *C. hispida* Brod.
= *C. Peziza* Gray.
= *C. Peziza*, var. *compressoconicum* Carp.
= *C. maculatum* Brod.
= *C. striatum* Brod., not Say.
= *C. auritum* Reeve.

It will be noticed that the West Indian forms, the Ceylon species, as well as the rest, are made varieties of *scutellatum*. Any person who has collected or handled a large number of the West American shells of this group is well aware of the excessive number of specific names that have been attached to what may reasonably be regarded as varieties, and that many of such names rest upon a very frivolous foundation. While Mr. Tryon's condensation of these is measurably warranted, with the ample material of the National collection before me I can not follow or approve *in toto* of his very radical modification.

The first objection to the above is the reducing of the spinose forms to a varietal position and the second is the inclusion of others described under the names of *pectinatum*, *serratum*, *concameratum*, *striatum*, and *auritum* in either of Tryon's *varietal* groups. One species not included in Tryon's enumeration is referred in his index to *Galerus* or *Trochita*, that is, *C. sordida* Brod. (Rve., Mono., sp. 22); this belongs with the species *pectinatum*, etc., above named, making all together six. In these the internal process or cup is distinctly separable from all the others, and the large National Museum series shows that under any modification of form due to the shape of the object to which the shell

was attached, whether resulting in the pinching together or compression of the sides, etc., the cuplike process is unaffected so far as relates to the proportion of the same that is attached to the inner surface. Carpenter's *pectinatum*, to which in manuscript he gave also the name *Jewetti* (U. S. Mus., No. 56264), figured in Reeve's Monograph in pl. v, 11, 11*a*, exhibits the characters and extent or proportion of the cup that is fixed to the side.

A careful examination of one hundred and thirty-four examples included in thirty-two lots from thirteen localities between Lower California, in the north, and Payta, Peru, in the south, discovered no connecting links between the usual form of the cup, as seen in the species of the imbricated group, and the triangular cup of the *pectinatum*, *serratum*, *etc.*, forms I have named. Besides the above example of *pectinatum*, which was collected at Mazatlan, the Museum series contains two from the "Gulf of California" (No. 60239), which, on previous and hasty identification, were wrongly determined as "*imbricatum* var.," and a fourth from Panama; the exterior sculpture is also persistent and characteristic, easily separable from the others of the *imbricated* group. Of the one hundred and ninety-four examples of the *spinose* form from nineteen localities between San Pedro, California, in the north, to Payta, Peru, in the south, and the Galapagos, in the National Museum, not one example occurs, whatever may be its shape, compressed or pinched, conical or flattened, wherein the internal cup is attached as in *pectinatum*, etc.; neither have I observed in the course of going over the two groups *imbricatum* and *spinosum* any difficulty in separating them or any reason for uniting them by reason of the occurrence of varietal forms wherein the characters are too indefinite for satisfactory determination.

The foregoing is printed as written nearly two years ago. Recently, in relation to the Tertiary fossils of Florida,* Dr. Dall has referred to this character of the attachment of the cup, and he assigns certain forms, wherein the cup is adherent, to *Dispotæa* (Say) Conrad.

Dispotæa as a section or subgenus of *Crucibulum* will therefore include *pectinatum* + *Jewetti*, *serratum*, *concameratum*, *striatum*, *auritum*, and *sordidum*.

In this portion of his paper Dr. Dall remarks, "the species of both groups [*Crucibulum s. s.; and Dispotæa*] have been very greatly overstated by naturalists who have assumed the constancy of the surface characters or those due to station." Farther on he says, "the Pacific *imbricatum*, except for the link furnished by the fossils, is quite distinct from its near relative, *C. spinosum*, but in the Pliocene fossils the intermediate forms are more numerous, and there the two can hardly be regarded as distinct species."

* Transactions Wagner Institute, Phila., Vol. III, part II, Dec. 1892.

Genus **CREPIDULA** Lamarck.

87. Crepidula aculeata Gmel.

Beach shells, rare.

Indefatigable and Hood islands (Mus. No. 102361). Dr. Jones found this form abundant on the mainland at Payta, Peru.

Family AMALTHEIDÆ.

Genus **AMALTHEA** Schumacher.

88. Amalthea Grayanus Mke.

= *Hipponyx Grayanus* Mke.

Beach shells, common.

Hood, Chatham, and Indefatigable islands. Several specimens in fair condition (Mus. Nos. 102358, 122108, 102464).

89. Amalthea antiquatus Linné

= *Hipponyx antiquatus* Linné.

Beach, several examples.

Indefatigable Island (Mus. No. 102465). Six rather small specimens from Chatham Island in Dr. Jones's collection. Wimmer's list also includes it.

90. Amalthea barbatus Sby.

= *Hipponyx barbatus* Sby.

Common on the beaches.

Chatham, James, Indefatigable, and Hood islands (Mus. Nos. 122109, 102466, 102357). Good, fresh examples were obtained at all of these islands. Dr. Jones's collection includes it from Chatham Island.

Family NATICIDÆ.

Genus **POLYNICES** Montfort.

91. Polynices dubia Recluz.

= *N. Atacamensis* Phil.

Beach, one example.

Indefatigable Island (Mus. No. 102472).

Tryon has included *N. amiculata* Phil. and *N. rapulum* Reeve in the synonymy of this species.

92. Polynices uber Val.

= *Mamma uberina* Orb.
+ *M. Phillipiana* Nyst.

Beach shells.

Indefatigable, Hood, and Charles islands (Nos. 102471 and 102368). *M. uberina* and *M. Phillipiana*, of Wimmer's list, are credited respectively to Bindloe and Hood islands.

Subgenus **LUNATIA** Gray.

93. Polynices (Lunatia) otis Brod.

+ var. *fusca* Cpr.
= *N. Galapagosa* Recluz.
= *N. perspicua* Recluz.
= *N. Salangoensis* Recluz.

Beach, broken shells.

Indefatigable Island (Mus. No. 102470). Found also on the mainland, as far south as Payta, by Dr. Jones.

Family LAMELLARIIDÆ.

Genus **LAMELLARIA** Montagu.

94. Lamellaria ? Stearnsii Dall.

Hood Island, one example in good condition (Mus. No. 102369).

The shell doubtfully assigned to the above species is quite small, only 5 millimeters long, possibly not adult. It resembles in a general way and is closer to Dall's *Stearnsii* than to any species that I am aware of; it has a narrower columella, however, than the species suggested. Without the soft parts it is doubtful whether its place is with this group or with *Marsenina*. Capt. Couthouy's species from Orange Harbor, Patagonia, *L. antarctica* and *L. prætenuis*, are represented by figures of the animals, but not the shells, and the *Albatross* example does not agree with E. A. Smith's *patagonica*.

95. Lamellaria ? rhombica Dall.

Beach.

Hood Island, one nearly perfect specimen.

Superfamily DOCOGLOSSA.

Family ACMÆIDÆ.

Genus **ACMÆA** Eschscholtz.

96. Acmæa scutum Orb.

Beach shells.

Hood and Indefatigable islands (Mus. No. 102359). Several specimens from Indefatigable.

97. Acmaea striata Rve.

not *A. striata* Q. & G.
? =*A. scutum*, Orb. var.

Beach.

Hood Island (Mus. No. 102360). Six small examples. Probably a variety of *scutum*. Carpenter regarded *S. striata* Rve. as a variety of *mesoleuca*.

Superfamily RHIPIDOGLOSSA.

Genus **OMPHALIUS** Philippi.

98. Trochus (Omphalius) Cooksoni Smith.

?=*O. fasciatus* Born.

Beach.

James Island (Mus. No. 102505). A single perfect individual, measuring 4 millimeters in height and 7 millimeters in diameter, not quite the same proportions, but no doubt belonging to the species described by Smith. The specimen before me is beautifully blotched with irregular whitish spots, on a ground color somewhat darker than the rest of the surface, forming a girdle above the umbilicus. It seems strange that the resemblance to *O. fasciatus* of the Antillean region has not heretofore been noticed. A comparison with the very large series of *fasciatus* in the National Museum shows that it is very closely related to that species, if not identical.

Family NERITIDÆ.

Genus **NERITA** Bruguiere.

99. Nerita scabricosta Lam.

= *N. ornata* Sby

Common on the beaches.

Hood, James, and Indefatigable islands (Mus. Nos. 102383, 102280, 102473). Fine large examples, many quite fresh.

Superfamily ZYGOBRANCHIA

Family FISSURELLIDÆ.

Genus **FISSURELLA** Bruguiere.

100. Fissurella macrotrema Sby.

Beach.

Indefatigable Island, one perfect junior (Mus. No. 122129).

101. Fissurella rugosa Sby.

Beach shells, in all conditions.

James, Hood, Indefatigable, Duncan, and Chatham islands. Numerous examples (Mus. Nos. 102366, 102453, 102317). The various aspects of this protean form were found on the beach margins of the several islands named, in most instances in fair condition.

102. Fissurella obscura Sby.

? = *F. rugosa* Sby., variety.

Beach.

Chatham Island (Mus. No. 122124). Several examples of this form, which may be regarded as probably a variety of the variable *rugosa*.

103. Fissurella virescens Sby.

Beach shells.

Chatham Island. One junior in good condition (Mus. No. 122115). Dr. Jones obtained five small specimens at this island.

104. Fissurella nigropunctata Sby.

= *F. virescens* Sby., var.

Beach examples.

Chatham Island. One junior in good condition (Mus. No. 122114).

Genus **FISSURIDEA** Swainson = **GLYPHIS** Carpenter, non Agassiz.

105. Fissuridea inæqualis Sby.

Beach shells in various conditions.

Hood, Indefatigable and Chatham islands, mostly from the first (Mus. Nos. 102367 and 122122).

In my list of Dr. Jones's South American shells, this species and *alta* were erroneously placed in Mr. Pilsbry's genus *Lucapinella.*

106. Fissuridea inæqualis Sby. var. **pica** Sby.

Beach specimen.

Indefatigable Island. A single example (Mus. No. 122121). Mr. Pilsbry is presumably right in assigning this to a varietal position.

107. Fissuridea saturnalis Cpr.

Beach specimen.

Chatham Island, two examples (Mus. No. 122123).

Subclass ISOPLEURA.

Order POLYPLACOPHORA.

Superfamily EOCHITONIA.

Family LOPHYRIDÆ.

Genus **CHITON** s. s.

108. Chiton Goodallii Brod.

Beach, fragments and live specimens.

Chatham and Albemarle Islands, one living example from each; Indefatigable, a single (anterior) plate (Mus. No. 102451). Suggests in a general way *C. magnificus.*

109. Chiton sulcatus, Wood.

Beach, valves, also living examples.

Indefatigable Islands, portion of posterior plate. Charles Island, three living specimens. Hood Island, one worn median valve of a very large individual (Mus. No. 102356).

CARPENTER'S REEVE-CUMING LIST.

The following list of Galapagos shells is made from Dr. Carpenter's Reports to the British Association. The special island is given whenever stated. The list of marine forms was compiled by Carpenter from Reeve's Monographs; the list of land shells* was furnished him by Cuming and contains several species not given by Reeve, and includes erroneously *Bulimus corneus* Sby., a Nicaraguan form. I have added such notes in brackets as may be of assistance in questions of comparison and reference:

1. Gastrochæna rugulosa Sby.
2. Gastrochæna brevis Sby.
3. Gastrochæna hyalina Sby.
4. Petricola amygdalina Sby.
5. Semele rupium Sby., Hood's Island.
6. Semele punctatum Sby.
7. Cardita incrassata Sby. [? error for crassa Sby.]
8. Cardita varia Brod. [=C. flammea Mich.]
9. Chama spinosa Schum. Hood's I. [? echinata var.]
10. Chama janus Rve. [?=frondosa var.]
11. Chama imbricata. [?=frondosa var.]
12. Modiola capax Cpr.
13. Crenella coarctata Dkr. [Modiolaria s. g.]
14. Byssoarca truncata Sby. [Arca g.]
15. Pecten magnificus Sby.
16. Lima Pacifica Rve., Hood's I. [=arcuata Sby.]
17. Lima arcuata Sby.
18. Anomia adamus Gray.
19. Bulla Quoyii Gray.
20. Bulla rufolabris A. Ad.
21. Bulimus nux Brod. [Bulimulus g.]
22. Bulimus verrucosus Pfr. Charles I. on bushes.
23. Bulimus unifasciatus Sby. Charles I.
24. Bulimus rugulosus Sby. Chatham I.
25. Bulimus eschariferus Sby.
26. Bulimus Darwinii Pfr. on bushes.
27. Bulimus achatinellinus Fbs.
28. Bulimus incrassatus Pfr.
29. Bulimus ustulatus Sby. Charles I. under lava.
30. Bulimus calvus Sby. James I. on tufts of dead grass.
31. Bulimus Jacobi Sby. James I., under scoriæ.
32. Bulimus chemnitzioides Fbs. [Pleuropyrgus g.]
33. Bulimus corneus Sby. [error: a Nicaraguan species.]
34. Bulimus sculpturatus Pfr.
35. Bulimus rugiferus Sby. James I., under scoriæ.
36. Bulimus nucula Pfr.
37. Bulimus Galapaganus Pfr.
38. Bulimus Manini Pfr.
39. Siphonaria gigas Sby.
40. Siphonaria scutellum Desh. [=obliquata Sby ?]
41. Lophyrus Goodallii Brod. [=Chiton g.]
42. Lophyrus sulcatus Wood [=Chiton g.]
43. Chiton hirudiniformis Sby.
44. Acmæa striata Reeve.
45. Fissurella rugosa Sby.
46. Fissurella macrotrema Sby. [=rugosa Sby. var.]
47. Fissurella nigropunctata Sby. [=virescens Sby. var.]
48. Fissurella mutabilis Sby.
49. Fissurella obscura Sby. [? F. rugosa Sby. var.]
50. Glyphis inæqualis Sby. [Fissuridea g.]
51. Turbo squamigera Rve. [Senectus g.]
52. Calyptræa varia Brod. [Mitrularia g.]
53. Hipponyx Grayanus Mke. [Amalthea g.]
54. Hipponyx barbatus Sby. [Amalthea g.]
55. Cerithium ocellatum Brug. Polynesia [?]
56. Cerithium nebulosum Sby. [=maculosum Kien.]
57. Cerithium Galapaginus Sby. [=interruptum Mke. var.]
58. Littorina porcata Phil.

* Brit. Assoc. Report 1856, p. 359.

59. Planaxis planicostata Sby.
60. Luponia nigropunctata Gray. [Cypræa g.]
61. Trivia pulla Gask.
62. Trivia fusca Gray [?]
63. Trivia radians Lam.
64. Trivia Pacifica Gray.
65. Trivia suffusa Gray [?]
66. Trivia rubescens Gray [?]
67. Trivia Maugeriæ Gray.
68. Cancellaria mitriformis Sby.
69. Cancellaria ? chrysostoma Sby.
70. Cancellaria hæmastoma Sby.
71. Strombus granulatus Swains.
72. Terebra ornata Gray.
73. Myurella frigata. [=Terebra strigata Sby.]
74. Drillia excentrica Sby.
75. Drillia bicolor Sby. [Crassispira s. g.]
76. Drillia rugifera Sby. [Crassispira s. g.]
77. Drillia albicostata Sby. [Crassispira s. g.]
78. Drillia splendidula Sby. [Crassispira s. g.]
79. Conus nux Brod. [See page ante.]
80. Conus brunneus Wood.
81. Conus minimus var. [=brunneus var.]
82. Conus varius var. [=brunneus var.]
83. Conus Luzonicus var. [=purpurascens var.]
84. Conus diadema Sby. [=brunneus var.]
85. Stylifer astericola Brod.
86. Cirsotrema diadema Sby.
87. Natica maroccana Chem.
88. Lunatia Galapagosa Recluz. [=otis var.]
89. Oniscia tuberculosa Rve. [Oniscidia g.]
90. Oniscia xanthostoma A. Ad. [Oniscidia g.]
91. Cassis coarctata Sby. [Levenia s.g.]
92. Cassis tenuis Gray. [Cypræacassis s. g.]
93.*Triton reticulatus Blve. [Colubraria s. g.]
94. Triton Sowerbyi Rve. [Colubraria s. g.]
95. Triton pictus Reeve. [Epidromus s. g.]
96. Triton clandestinus Lam. [Simpulum s. g.]?
97. Lathirus ceratus Gray,
98. Lathirus tuberculatus Brod.
99. Lathirus varicosus Rve.
100. Mitra gausapata Rve. [Costellaria s. g.]
101. Mitra gratiosa Rve. [Thala s. g.]
102. Mitra muricata Swains. [=lens Wood.]
103. Strigatella tristis Brod. [=Mitra g.]
104. Strigatella effusa Swains. [=Mitra g.]
105. Olivella kaleontina Duclos. [=Oliva g.]
106. Purpura Carolensis Rve. Charles I. [=triangularis Blve.]
107. Purpura patula Linné.
108. Purpura columellaris Lam. [=Purpurella s. g.]
109. Purpura planospira Lam. James I. [=Planathais s. g.]
110. Vitularia salebrosa King.
111. Monoceros grande Gray. James I.
112. Engina carbonaria Rve.
113. Engina pulchra Rve. [=E. Reeviana C. B. Ad.]
114. Engina pyrostoma Sby.
115. Engina maura Sby. [?]
116. Engina crocostoma Rve. [=carbonaria var.]
117. Engina zonata Rve. Charles I.
118. Columbella hæmastoma Sby.
119. Columbella varians Sby. [Anachis g.]
120. Columbella unicolor Sby. [Alia s. g.]
121. Pseudo-Buccinum biliratum Couthouy, Reeve. [Tritonidea s. g.]
122. Engina (Buccinum) pulchrum. [See No. 113.]
123. Nassa nodifera Powis. [=tegula Rve.]
124. Nassa angulifera A. Ad.
125. Nassa nodicincta A. Ad.
126. Fusus Dupetithouarsii Kien.
127. Anachis nigricans Sby.
128. Anachis atramentaria Sby. Chatham I.
129. Anachis rugulosa Sby.
130. Strombina bicanalifera Sby.
131. Strombina lanceolata Kien.
132. Pisania cinis Rve. [Tritonidea s. g.]
133. Murex pumilus A. Ad. [Ocinebra g.]?
134. Murex nucleus Brod. [Purpura g.]

* To the Tritons should be added *T. lineatus* Brod., found in coral sand at the depth of about 6 fathoms. Cuming—Reeve's Monog., species 4, fig. 4, 4 *a*, *b*.

ALBERS' LIST.*

Under the generic title of *Nesiotes*, Albers included all of the Galapagos Bulimi known at the time, with the exception of Forbes's *achatinellinus* and *chemnitzioides*. Albers first used the name *Næsiotus* in 1850, afterwards as revised, Nesiotes in 1860; the latter has since been used in Coleoptera and Hemiptera by various entomological writers. Schlütter's *Omphalostyla* (1838) is probably not the same group as the Galapagos shells.

1. nux Brod.
2. nuciformis Petit.
3. sculpturatus Pfr.
4. asperatus Albers
5. incrassatus Pfr.
6. Darwini Pfr.
7. unifasciatus Sby.
8. ustulatus Sby.
9. galapaganus Pfr.
10. Jacobi Sby.
11. nucula Pfr.
12. calvus Sby.
13. rugiferus Sby.
14. eschariferus Sby.
15. rugulosus Sby.

Of Albers' list of fifteen as above, four, namely, *nuciformis*, *asperatus*, *incrassatus*, and *nucula*, should be regarded as varieties or synonyms of *nux*. Pfeiffer's section *Rhaphiellus* of Ehrenberg's genus *Buliminus* is based upon Forbes's *Bulimus achatinellinus*† and includes only this solitary species.

It would seem that geographical considerations would cause one to hesitate before placing any Galapagos form in Ehrenberg's genus. In the light of to-day, it is an interesting illustration of or commentary on the extreme systematization, to which the pulmonata-geophila, all the world over, have been subjected.

The relations of *achatinellinus* to the other Galapagos forms can not be satisfactorily determined until a larger series has been collected and examined, and the peculiarities of station and habits have been observed.

As to generic or subgeneric titles, one may well ask why *Pleuropyrgus* for the Galapagos forms, like Forbes's *chemnitzioides*, when we have *Pyrgus turritus* Brod. (Reeve, 124) from "Truxillo, Peru," before us.

It is highly probable that the well characterized insular groups of Bulimoids, *Achatinella* and *Partula* of the Sandwich and Society islands, respectively, influenced authors to the extent of causing them to regard the Galapagos forms as an analogous group worthy to be known by a distinguishing name.

THE PETREL-COOKSON SHELLS.

Commander Cookson, in command of H. M. S. *Petrel*, visited Charles, Abingdon, and Albemarle islands in June, 1875. The shells collected by him were determined by Mr. E. A. Smith, of the British Museum,

* Von Marten's Albers' Die Heliceen, etc., Leipzig, 1860, Ed. II.

† Proc. Zool. Soc., London, 1850, p. 56.

from whose paper I have quoted as below. He remarks,* "the shells collected by Commander Cookson are all from Charles Island. They belong to twenty-two species, the majority of which were previously known to have been found in the archipelago, though we were ignorant in some instances of the island on which they were found. Six of the species are additions to this fauna, three of them being apparently undescribed."

1. Purpura patula Linné.*
2. Purpura callaoensis Gray.
3. Engina crocostoma Rve.
4. Rhizochilus (Coralliophila) parvus Smith. A new species.
5. Columbella fuscata Sby.
6. Lathirus varicosus Rve.
7. Lathirus tuberculatus Brod.
8. Mitra (Strigatella) tristis Swains.
9. Conus nux Brod.
10. Cerithium maculosum Kien.
11. Calyptræa sp.
12. Hipponyx Grayanus, var., Mke.
13. Trochus (Omphalius) Cooksoni Smith. A new species.†
14. Fissurella obscura Sby.
15. Chiton (Lophyrus) Goodallii Brod.
16. Chiton (Lophyrus) sulcatus Wood.
17. Arca sp. "Seems most nearly allied to *A. gradata* Brod. & Sby."
18. Bulimus nux Brod.
19. Bulimus unifasciatus Sby.
20. Bulimus eschariferus Sby.
21. Succinea Bettii, Smith.

[18]. "The specimens of this species collected by Commander Cookson are very coarsely striated, and much darker in color than those described by Broderip. They are striped longitudinally with a mixture of slate color and brown, with here and there some pale streaks; and some specimens have a distinct pale band around the middle of the body-whorl; and the four apical whorls are bluish black.

"This species is considerably variable in form, some examples being much more elongate than others.

"The following measurements show how great is the variation in length. One shell is 20 millims. long and 10 in diameter, and another very short one has a length of only 16 millims., and yet is the same width as the longer specimen."

[20]. "This species is quoted by Reeve as having been found at Chatham Island by Darwin. The Charles Island shells are considerably larger than those from the above locality, and also coarser in sculpture, some of them displaying spiral granose or rugose striation as in *B. rugulosus* of Sowerby, from the same islands; and, indeed, they appear to be an intermediate variety or connecting link between the two species, both as regards size and sculpture. The largest specimen measures 19 millims. in length and 7½ in width."

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*Proc. Zool. Soc. London, 1877, p. 64 *et seq.*

*"Both the normal form and the variety (*P. columellaris*) occur at Charles Island." Mr. Smith notices the diminutive size of occasional adult examples of the latter form.

†The author says "it bears a faint relationship to *T. occultus Phil.*, but is more conoid and more strongly sculptured." As the number of examples is not stated, it may be assumed that the author had but a single specimen as the basis of his description.

[21]. A new species, of which the author says the species "is most nearly allied to *S. rubicunda* Pfr., which was described as coming from the island of Masafuera, off the coast of Chile."

"Long., 13 millim.; diam., maxima 8. Apertura longit., 10 millim.; diam., 5¾." Also a "var. *Testa brevior*."

WIMMER'S* LIST OF HABEL'S GALAPAGOS SHELLS—SUMMARY.

1. Murex regius Wood. [Phyllonotus s. g.]
2. Cantharus hæmastoma Gray. [=Tritonidea sanguinolenta Duclos.]
3. Tritonium pileare L. [?=T. (Lampusia) vestitus Hinds.]
4. Nassa versicolor C. B. Ad.
5. Purpura columellaris Lam. [Purpurella s. g.]
6. Purpura planospira Lam. [Planathais s. g.]
7. Purpura melones Duclos. [P melo.]
8. Acanthina grandis Gray. [Monoceros g.]
9. Conchopatella peruviana Lam. [=Concholepas g.]
10. Rhizochilus madreporarum Sow.
11. Rhizochilus parvus Edgar Smith.
12. Latirus varicosus Reeve.
13. Peristernia tuberculata Brod. [Latirus g.]
14. Strigatella tristis Swains. [Mitra g.]
15. Strigatella effusa Swains. [Mitra g.]
16. ?Turricula crenata Brod. [Mitra g.]
17. Columbella castanea Sow.
18. Columbella fuscata Sow.
19. Columbella hæmastoma Sow.
20. Columbella cribraria Quoy et Gaim. [=Nitidella cribraria. Lam.]
21. Columbella suffusa Sow. [Anachis s. g.]
22. Columbella atramentaria Sow. [Anachis s. g.]
23. Columbella rugulosa Sow. [Anachis s. g.]
24. Amycla sp.
25. ?Amycla pulchella Sow. [?=Anachis elegantula Morch.]
26. Engina crocostoma Reeve. [=E. carbonaria var.]
27. Volvaria rubella C. B. Ad. [Volvarina s. g.]
28. Volvaria varia Sow. [=Marginella (Volvarina) varia.]
29. Cadium ringens Swains. [Malea g.]
30. Mamma uberina D'Orb. [=Polynices uber Val.]
31. Mamma Philippina Nyst. [=Polynices uber Val.]
32. Mamma otis Brod. [=Lunatia otis.]
33. Naticina pellucida Reeve. [Sigaratus g.]
34. Morum tuberculosum Sow. [Oniscidia g.]
35. Cassidea tenuis Gray. [Cypræcassis g.]
36. Cirsotrema diadema Sow.
37. Acus strigata Sow. [Terebra g.]
38. Eulima micans Carpent.
39. Stylifer astericola Brod et Sow.
40. Cythara oryza Hinds. [Mangilia g.]
41. Conus brunneus (Mawe), Gray. [C. brunneus Wood.]
42. Conus coronatus Dillwyn. [=C. brunneus Wood var.]
43. Conus nux Brod.
44. Leptoconus regalitatis Sow. [=C. purpurascens var.]
45. Cypræa exanthema L.
46. Luponia albuginosa (Mawe) Gray. [Cypræa g.]
47. Luponia nigropunctata Gray. [Cypræa g.]
48. Trivia Maugeriæ Gray.
49. Trivia pacifica Gray.
50. Trivia pulla Gaskoin.
51. Cerithium adustum Kiener. [=C. maculosum Kien., var.]
52. Triphoris? alternatus C. B. Ad. [Triforis g.]
53. Lacuna porrecta Carp.
54. Hamus lemniscatus Phil. [Tectarius g.]
55. Hamus trochoides Gray. [Tectarius g.]

*Zur Conchylien Fauna der Galapagos Inseln von August Wimmer, November, 1879. Akad. der Wissensch. The species herein listed were collected by Dr. Simeon Habel in 1868.

56. Rissoina fortis C. B. Ad.
57. Rissoina inca C. B. Ad.
58. Alvania sp.
59. Siphonium margaritarum Val.
60. Siphonium squamigerum Carp. [Serpulorbis g.]
61. Siphonium pellucidum Brod et Sow.
62. Calyptræa varia Brod. [Mitrularia g.]
63. Cochlolepas barbata Sow. [Amalthea g.]
64. Cochlolepas Grayana Menk. [Amalthea g.]
65. Cochlolepas subrufa Sow. [Amalthea g.]
66. Amalthea antiquata L.
67. Nerita ornata Sow. [=N. scabricosta Lam.]
68. Nerita Bernhardi Recl.
69. Omphalius Cooksoni Edgar Smith. [Trochus g.]
70. Omphalius reticulatus Wood. [Trochus g.]
71. Fissurella macrotrema Sow. [=F. rugosa Sby. var.]
72. Fissurella obscura Sow. [=? F. rugosa Sby. var.]
73. Lucapina alta C. B. Ad. [Fissuridea g.]
74. Lucapina inæqualis Sow. [Fissuridea g.]
75. Lucapina mus Reeve. [Fissuridea g.]
76. Tectura patina Eschsch. [Acmæa g.]
77. Tectura spectrum Nutt.. [Acmæa g.]
78. Nacella? subspiralis Carp.
79. Lophyrus Goodallii Brod. [Chiton g.]
80. Lophyrus sulcatus Wood. [Chiton g.]
81. Lepidopleurus janeirensis Gray. [Chiton.]
82. Acanthochites hirudiniformis Sow. [Chiton.]
83. Bulla rufilabris A. Ad.
84. Janthina fragilis Lam.
85. Bulimulus achatinellinus Forb.
86. Bulimulus Darwinii Pffr.
87. Ellobium stagnale Petit. [Auricula g.]
88. Melampus trilineatus C. B. Adams.
89. Tralia panamensis C. B. Ad.
90. Pedipes angulatus C. B. Ad.
91. Lucina fibula Ad. et Reeve.
92. Lucina punctata L.
93. Actinobolus varius Brod. [Cardita g.]
94. Mytilus Adamsianus Dunker.
95. Margaritifera? Cumingii Reeve. [Meleagrina g.]
96. Isognomon legumen Gmel. [Perna g.]
97. Isognomon quadrangulare Reeve [Perna g.]
98. Barbatia decussata Sow. [Arca.]
99. Barbatia velata Sow. [Arca.]
100. Barbatia divaricata Sow. [Arca.]
101. Barbatia gradata Brod. et Sow. [Arca.]
102. Radula arcuata Sow. [Lima g.]
103. Ostrea glomerata Gould.

ANCEY'S GALAPAGOS SPECIES, ETC.

In the *Bulletin of the Sociétié Malac. de France** Mr. C. F. Ancey, under the title of "Nouvelles Contributions Malacologiques," has described *Bulimulus amastroides;* in connection with the description he refers to *B. calvus* Sowerby as the only species with which it may be compared, but his shell has a "facies général très différent," form more oval, less height, and a more delicate sculpture.

His varieties of *B. rugulosus* Sby., namely, *infuscata* and *planospira*, and of *B. eschariferus* Sby., *bizonalis*, and *subconoidalis*, have already been mentioned.

In speaking of the Galapagos Bulimoids he says: "Les Bulimes appartiennent incontestablement au système américaine, mais ils se sont modifiés peu à peu, grâce à la nature volcanique de ces îles et à leur position géographique."

* Juillet 1887, IV, pp. 293–299.

As to the relationship of the Galapagos Bulimi to many of the forms inhabiting various subregions in the general one of the South American main, compare *B. bilineatus* Sby. in Reeve, No. 132, from "St. Elena and west Columbia," with certain aspects of *rugulosus* Reeve's No. 121. Without making an exhaustive or even systematic search for analogies in form, sculpture and general facies, a random reference includes such species as *pustulosus* Brod., *rhodacme* Pfr., and *pupiformis* Brod., from Huasco; *pruinosus* Sby., and *scalariformis* Brod., from Peru; *modestus* Brod., *albicans* Brod., *affinis* Brod., *arrosus* Brod., and *punctulifer* from Chile; *striatus* King and *striatulus* of Sby., *montivagus* Orb., Bolivia; *sordidus* Lesson, *apodometes* Orb., *Laurentii* Sby., Chile and Peru, and *limonoicus*, Orb., also from Peru; *Torallyi* Orb., *trochoides* Orb., and *crepundia* Orb., three Bolivian forms. But it is not simply to these as figured in the monographs, but to the shells themselves that attention is called; many of the species above named it would be quite impossible to represent satisfactorily by one, two, or three figures, or by the same number of examples; the variation which many of them exhibit is so great, that a large series is absolutely necessary.

It will be noticed that the mainland forms suggested by me for comparison with the Galapagos shells are principally Chilian and Peruvian; from the former especially. It would seem so far as the Bulimoids are considered, that the islands were stocked from this part of the continent rather than from Ecuador and farther north.

REIBISCH'S WOLF COLLECTION.

Die conchyliologische Fauna der Galapagos-Inseln, von Paul Reibisch (mit Tafel I und II),* includes the following, being an annotated and descriptive catalogue or summary of the terrestrial species previously described and of others regarded by the author as new and described as such. The material which Reibisch had before him was collected by Dr. Theodor Wolf, State geologist of Ecuador, but the number of examples seems to have been exceedingly limited and generally in an unsatisfactory condition; either immature, weathered, or in some other way imperfect.

For the sake of continuity I have quoted herein from Reibisch's papers all of the previously described species which he has included, following his numbers, though in some cases he has added nothing to our previous knowledge. In other instances the information he has given as to station, altitude, etc., is of sufficient interest to make the publication desirable.

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*Ges. Isis in Dresden, 1892, Abh. 3.

I. BULIMULUS Leach.

1. Bulimulus eschariferus Sow.

HABITAT.—Chatham Island (Darwin).

2. Bulimulus unifasciatus Sow.

HABITAT.—Charles Island (Cuming, Wolf). One example, a dead shell without epidermis.

3. Bulimulus nucula Pfr.

HABITAT.—Charles Island (Wolf). Three examples, only one perfect. "The smallest of the group of *B. nux*."

4. Balimulus verrucosus Pfr.

HABITAT.—Galapagos (teste Pfeiffer, l. c.).

5. Bulimulus asperatus Albers.

HABITAT.—Charles Island (Wolf). "Five examples, all without epidermis."

6. Bulimulus nux Brod.

HABITAT.—Charles Island (Cuming, Wolf). At an elevation of 300 to 600 feet, in the dry zone; only a few imperfect examples collected "under bushes and stones."

7. Bulimulus incrassatus Pfr.

HABITAT.—Chatham Island (Wolf). Not rare at an elevation of 900 to 2000 feet in the wooded region, on bushes, with *B. Chemnitzioides* Forbes and *B. terebra*, Reib., [*B.* (=*Pleuropyrgus*) *Habeli* Stearns]; also variety *sulcatus*, Reib. Habitat, Charles Island (Wolf); also variety *nuciformis* Petit, Habitat, Galapagos (Hanet-Clery), Charles Island (Wolf).

Reibisch here comments briefly on the plasticity of the *B. nux* form.

8. Bulimulus ustulatus Sow.

HABITAT.—Charles Island (Cuming, Wolf). Color bands are more conspicuous than the sculpture.

9. Bulimulus invalidus Reib.

HABITAT.—Charles Island (Wolf).

10. Bulimulus venustus Reib.

HABITAT.—Charles Island (Wolf). The author says of this, it is close to *ustulatus*.

11. Bulimulus calvus Sow.

HABITAT.—James Island (Cuming); Charles Island (Wolf).

12. Bulimulus Jacobi Sow.

HABITAT.—James Island (Cuming).

13. Bulimulus pallidus Reib.

HABITAT.—Albemarle Island (Wolf), in the dry zone, 200 to 800 feet altitude, under stones and bushes. Of four examples only one was perfect.

14. Bulimulus cinereus Reib.

HABITAT.—James Island (Wolf). The description of this species, according to the author, rests on two examples in poor condition.

15. Bulimulus rugulosus Sby.

HABITAT.—Chatham Island (Cuming, Wolf), 300 to 600 feet; common on bushes on the cliffs and under stones; the prevailing form on Chatham, as *B. nux* is on Charles Island.

16. Bulimulus ventrosus Reib.

HABITAT.—Barrington Island (Wolf). Common on the whole island; holds a similar position here that *nux*, *rugulosus*, and *Wolfi* maintain in the other islands. The form is inconstant and variable. Three examples, one imperfect.

Variety β.

HABITAT.—Chatham Island (Wolf). Two examples, more shiny and darker colored than the Barrington specimens.

17. Bulimulus galapaganus Pfr.

HABITAT.—Galapagos (teste Pfeiffer *l. c.*), Barrington, Wolf. Of the foregoing species, numbered 15, 16, and 17, Reibisch remarks they form a subgroup restricted to the eastern part of the archipelago.

18. Bulimulus acutus Reib.

HABITAT.—Chatham Island (Wolf), at an elevation of 900 to 2,000 feet; very abundant in grassy spots and on the trunks of trees. Two mature, one adolescent examples.

19. Bulimulus curtus Reib.

HABITAT.—Chatham Island (Wolf), 900 to 2,000 feet. Very abundant in grassy places and on the trunks of trees. The author remarks that it forms, with *B. acutus*, a peculiar group restricted in distribution so far as known to Chatham Island.

20. Bulimulus rugiferus Sow.

HABITAT.—James Island (Cuming).

21. Bulimulus nudus Reib.

HABITAT.—Charles Island (Wolf). The author says of this that in form it stands between *sculpturatus* and *rugiferus*, but differs from said species in size, and the sculpture is less distinct. The description rests on two examples, weathered (calcinerten).

22. Bulimulus sculpturatus, Pfr.

HABITAT.—Galapagos (Darwin).

23. Bulimulus Darwini Pfr.

HABITAT—Galapagos (Darwin).

24. Bulimulus Wolfi Reib.

HABITAT.—Indefatigable Island, on lava cliffs, under stones, etc. This is said to be characteristic of Indefatigable Island, as *rugulosus* is of Chatham and *nux* of Charles Island. Number of examples three, two grown and one immature. Very close to *Darwini*, but differs in having a third tooth, occurring on the outer lip.

25. Bulimulus Simrothi Reib.

HABITAT.—Albemarle Island (Wolf). Not common, in the tree-clad region 1,000 to 2,000 feet elevation; represented by three individuals which may not be fully grown; one of these is deformed. Reibisch remarks that the first eleven species are limited to Charles and Chatham islands;* the latter (No. 11) up to this time observed in only two places. The *rugulosus* and *curtus* groups are restricted to Barrington and Chatham, and 20 to 25 grouped or subgrouped under *Darwini*, as a type, occur on Charles, Indefatigable, James, and Albemarle. Here also comes in as a subgroup *B. Jacobi.*

26. Bulimulus (Pleuropyrgus) terebra Reib.

[*B.* (*Pleuropyrgus*) *Habeli* Stearns. The Nautilus, January, 1892, pp. 98–99.]

HABITAT.—Chatham Island (Wolf), at an elevation of 900 to 2,000 feet in the wooded region, on mossy rocks and under stones; abundant. Four examples, of which hardly one is well preserved.

27. Bulimulus (Pleuropyrgus) chemnitzioides Fbs.

HABITAT.—Chatham Island (Wolf), station 300 to 600 feet altitude; abundant on rocks and under stones, along with *B. rugulosus*.

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*Revising the distribution as given above by Reibisch of the first eleven species, which includes *B. nux*, Albermarle must be credited with that species on the proof of *Albatross* examples, and *Darwini*, which he includes in his numbers 20 to 25, must be credited to Bindloe as given by Wimmer.

28. Bulimulus (Pleuropyrgus) lima Reib.

HABITAT.—Chatham Island (Wolf). Rare; occurring with *P. terebra*; only two examples detected, one of these possibly a junior.

Judging by his figure, I should regard the above as a dwarfed or adolescent form of *chemnitzioides.*

Reibisch observes that this group, *Pleuropyrgus*, seems to be restricted to Chatham Island. With our present limited knowledge of the land mollusks of the Galapagos group it would appear so, but much more light is needed to make generalizations of any great value.

29. Bulimulus (Pelecostoma) canaliferus Reib.

HABITAT.—Chatham Island (Wolf). Abundant in moss at an elevation of 900 to 2,000 feet. Four mature individuals.

This may prove to be a valid species; the figure is unsatisfactory; it suggests relationship to *rugifera* and may be a dwarfed variety of that species.

30. Bulimulus (Pelecostoma) cymatoferus Reib.

HABITAT.—Chatham Island (Wolf). "Immature examples" seem to have been regarded as a sufficient foundation for this species, of which the soft parts are unknown, and the genus must rest on shell characters only.

The above is figured in pl. II, 7, of Reibisch's paper; it is Dall's *Leptinaria chathamensis*,* a subgenus of *Stenogyra* in the family *Stenogyridæ.*

II. BULIMINUS Ehrenberg.

31. Buliminus (Rhaphiellus) achatinellinus Forbes.

HABITAT.—Galapagos (Cuming), Chatham Island (Wolf), on mossy rocks at an elevation of 900 to 2,000 feet; apparently rare; no good live examples detected. Reibisch says the sole example figured differs in several particulars from that given in Pfeiffer.

II. PUPA Draparnaud.

32. Pupa (Leucochila) munita Reib.

HABITAT.—Albemarle Island (Wolf), "on bushes near the shore," close to *P. Wolfi*, which is abundant in the province of Guayaquil, Ecuador.

33. Pupa (Leucochila) clausa Reib.

HABITAT.—Indefatigable Island (Wolf).

On bushes near the shore. Reibisch implies that this is a more developed form of *P. Wolfi.*

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* Nautilus, January, 1892.

IV. SUCCINEA, Draparnaud.

34. Succinea (Tapada) Bettii Smith.

HABITAT.—Chatham Island (E. A. Smith, *l. c.*).

35. Succinea (Tapada) Wolfi Reib.

HABITAT.—Chatham Island (Wolf).

In the wooded region, 900 to 2,000 feet above the sea, abundant in moss and among rocks; also var. *producta*, a more elongated, slenderer form than the typical *Wolfi*, represented by a single individual; station same as type form.

V. HELICINA Lamarck.

36. Helicina Wolfi Reib. (Pl. II, Fig. 13.)

HABITAT.—Chatham Island (Wolf). Station same as the above *Succineas*, 900 to 2,000 feet altitude, among the mosses and rocks. This form was previously described by Dall, and was named by him *nesiotica*, see *Helicina* (*Idesa*) *nesiotica* in "The Nautilus" for January, 1892.

Of Reibisch's *invalidus* (No. 9) and his (No. 10) *venustus*, the number of examples that he had is not stated. If one may judge of these by the following, it may be assumed that the number was quite inadequate.

Of *pallidus* (No. 13) *four*, only *one* of which was *perfect; cinereus* (No. 14), *two* in poor condition; *ventrosus* (No. 16), *three* examples, one imperfect; *acutus* (No. 18), *two* mature *one* adolescent example; *nudus* (No. 21), *two* examples weathered; *Wolfi* (No. 24), *three* specimens, two grown, one immature; *Simrothi* (No. 25), *three* individuals which may not be fully grown; one of these is deformed.

The extreme variation of these Galapagos bulimoids is so great that it may ultimately be found that what are now regarded as three species, *Darwinii*, *rugiferus* and *sculpturatus*, plus callosities and color, are varieties of one. To these should be added Reibisch's *Wolfi*, which probably belongs to *Darwini*, the *third tooth* on the outer lip which constitutes the difference, is of insignificant value.

DR. JONES'S CHATHAM ISLAND, GALAPAGOS SHELLS.*

1. Mytilus cuneiformis Reeve=M. augustanus Lam.
2. Tellina (Capsa) excavata Sby.
3. Mactra velata Phil.
4. Bulla punctulata A. Ad.
5. Conus lucidus Mawe.
6. Conus nux Brod.
7. Oliva peruviana Lam.
8. Fusus Dupetithouarsii Kien.
9. Purpura melo Duclos.
10. Purpura patula Linné.
11. Purpura patula var.
12. Monoceros tuberculatum Gray + Purpura muricata Gray.
13. Ianthina fragilis Lam.=I. striatula Cpr.
14. Oniscidea tuberculosa Brod.
15. Cerithium maculosum Kien.
16. Amalthea antiquata Linné.
17. Amalthea barbata Sby.
18. Acmæa scutum Orb.
19. Fissurella virescens Sby.

* List of shells collected on the west coast of South America, principally between latitudes 7° 30′ south and 8° 49′ north, Proc. U. S. Nat. Mus., Vol. XIV, pp. 307–335. 1891.

DALL'S GALAPAGOS SPECIES.

In Mr. Dall's "Preliminary Report* on the Collection of Mollusca and Brachiopoda obtained in 1887–'88" on the voyage of the U. S. Fish Commission steamer *Albatross* from Fortress Monroe to California, etc., the following new species are described by him, and are recorded as occurring "near the Galapagos Islands," having been dredged at the stations indicated.

1. **Leda pontonia** Dall.

Stations 2807 and 2808, 812 and 634 fathoms, mud and sand.

2. **Verticordia perplicata** Dall.

Station 2807, in 812 fathoms.

3. **Dentalium megathyris** Dall.

Station 2807, in 812 fathoms; this form was also dredged off Chiloe Island and southwest Chili at stations 2788 and 2789, in 1,050 and 1,342 fathoms.

4. **Actæon perconicus** Dall.

"Near the Galapagos" * * * 812 fathoms.

5. **Scaphander interruptus** Dall.

Station 2807, * * * 812 fathoms.

6. **Pleurotoma exulans** Dall.

Station 2808, * * * 634 fathoms.

7. **Calliotectum vernicosum** Dall.

Station 2807, * * * in 812 fathoms.

8. **Pleurotomella argeta** Dall.

Station 2807, * * * 812 fathoms.

9. **Pleurotomella (Gymnobela) agonia** Dall.

Stations 2807 and 2808.

10. **Pleurotomella suffusa** Dall.

Station 2807.

11. **Chrysodomus (Sipho) testudinis** Dall.

Station 2807.

12. **Nassa Townsendi** Dall.

Station 2807.

13. **Scala pompholyx** Dall.

Station 2807.

* Proc. U. S. Nat. Mus., Vol. XII, pp. 219–362, pls. V–XV, 1889.

14. Gaza Rathbuni Dall.

Station 2818, in 392 fathoms.

15. Haliotis Pourtalesii? Dall.

Station 2815, in 33 fathoms, sand, near Charles Island.

Subsequently in the "Nautilus," January, 1892, Mr. Dall described the following terrestrial forms collected by Dr. G. Baur.

16. Helicina (Idesa) nesiotica Dall.

The first species of the family reported from the Galapagos; Chatham Island, on leaves of plants 1,600 feet above the sea. Mr. Dall remarks, "the type is not unknown in the Panamic region, but is said to be absent from the west slope of the Andes."

17. Leptinaria chathamensis Dall.

"Chatham Island, on ferns at 1,600 to 2,000 feet above the sea. Somewhat analogous forms are found in the mountains of the Panamic region."

18. Zonites (Hyalinia) Bauri Dall.

"South Albemarle Island, on weathered bones of tortoises. * * * The absence of any form of Helix or Zonites has been commented on by most of those naturalists who have treated of the Galapagos shell-fauna, and it was certainly a most extraordinary deficiency from any point of view. This discovery of Dr. Baur's removes the most striking anomaly of the fauna."

LIST OF THE MOLLUSK-FAUNA OF THE GALAPAGOS ISLANDS, COMPILED FROM THE FOREGOING.

Class PELECYPODA.

Order PRIONODESMACEA.

Suborder OSTRACEA.

Family OSTREIDÆ.

Genus **OSTREA** Linné.

1. **Ostrea folium** Gmel.

James Island, *Albatross*.

2. **Ostrea glomerata** Gould.

Galapagos, Wimmer.

Suborder ANOMIACEA.

Family ANOMIIDÆ.

Genus **ANOMIA** Linné.

3. **Anomia adamus** Gray.

=*A lampe* Gray.

James, *Albatross*; Galapagos, Carpenter.

Suborder PECTINACEA.

Family PECTINIDÆ.

Genus **PECTEN** Müller.

4. **Pecten subnodosus** Sby.

James Island, *Albatross*.

5. **Pecten magnificus** Sby.

Galapagos, Carpenter.

Family LIMIDÆ.

Genus **LIMA** Bruguiere.

6. **Lima arcuata** Sby.

James Island, *Albatross;* Galapagos, Carpenter, Wimmer.

7. **Lima pacifica** Reeve.

Hood Island, Carpenter.

Suborder **MYTILACEA.**

Family AVICULIDÆ.

Genus **Avicula** Lamarck.

8. **Avicula Cumingii** Reeve.

Galapagos, Wimmer.

Genus **PERNA** Bruguiere.

9. **Perna Chemnitzianus** Orb.

= *Isognomon C.* Auct.

Indefatigable and Hood Islands, *Albatross.*

10. **Perna legumen** Gmelin.

Hood Island, Wimmer.

11. **Perna quadrangulare** Reeve.

Charles Island, Wimmer.

Family MYTILIDÆ.

Genus **MYTILUS** Linné.

12. **Mytilus multiformis** Cpr.

Hood Island, *Albatross.*

13. **Mytilus Adamseanus** Dkr.

Hood Island, Wimmer.

14. **Mytilus cuneiformis** Reeve.

Chatham Island, Jones.

Genus **SEPTIFER** Recluz.

15. **Septifer Cumingianus** Dkr.

Hood Island, *Albatross.*

Genus **MODIOLA** Lamarck.

16. **Modiola capax** Cpr.

Hood Island, *Albatross;* Galapagos, Carpenter.

Genus **MODIOLARIA** Beck.

17. **Modiolaria coarctata** Dkr.

Galapagos, Carpenter.

Suborder ARCACEA.

Family ARCIDÆ.

Genus **ARCA** Lamarck.

18. Arca truncata Sby.

Galapagos Islands, Carpenter.

Subgenus **BYSSOARCA** Swainson.

19. Arca (Byssoarca), solida Sby.

Indefatigable Island, *Albatross*.

20. Byssoarca gradata B. & S.

Hood Island, *Albatross*, Wimmer; Charles Island, Petrel; James, Chatham, and Indefatigable islands, *Albatross*.

21. Byssoarca Reeviana Orb.

Hood, James, and Indefatigable islands, *Albatross*.

Genus **BARBATIA** Gray.

22. Barbatia velata Sby.

Hood Island, Wimmer.

23. Barbatia decussata Sby.

Hood Island, Wimmer.

Genus **DAPHNODERMA** Mont., not Poli.

24. Daphnoderma divaricata Sby.

Galapagos Islands, Wimmer.

Family LEDIDÆ.

Genus **LEDA** Schumacher.

25. Leda pontonia Dall.

Off Galapagos, 634 fathoms, *Albatross*.

Order TELEODESMACEA.

Suborder CARDITACEA.

Family CARDITIDÆ.

Genus **CARDITA** Bruguieré.

Subgenus **VENERICARDIA** Lamarck.

26. Cardita flammea Mich.

= *C. varia*, Brod.

Hood and James islands; *Albatross;* Bindloe, Wimmer; Galapagos, Carpenter.

27. Cardita crassa Sby.

? = *incrassata* Sby.

Galapagos Islands; Carpenter.

Suborder LUCINACEA.

Family LUCINIDÆ.

Genus LUCINA Brugieré.

Subgenus LUCINA s. s.

28. Lucina bella Conrad.

Hood, James, and Chatham islands; *Albatross*.

29. Lucina punctata Linné.

Hood Island, Wimmer.

30. Lucina fibula Ad. & Rve.

Hood Island, Wimmer.

Suborder CHAMACEA.

Family CHAMIDÆ.

Genus CHAMA Bruguieré.

31. Chama echinata Brod.

Indefatigable and James islands; *Albatross*.

32. Chama frondosa Brod.

Hood and James islands, *Albatross*.

33. Chama imbricata Brod.

Galapagos Islands, Carpenter.

34. Chama inquinata Brod.

Indefatigable Island, *Albatross*.

35. Chama Janus Reeve.

Galapagos Islands, Carpenter.

36. Chama spinosa Brod.

Hood Island, Carpenter.

Suborder CARDIACEA.

Family CARDIIDÆ.

Genus CARDIUM, Lamarck.

37. Cardium consors Brod.

James Island, *Albatross*.

Suborder VENERACEA.

Family VENERIDÆ.

Genus **CHIONE** Megerle.

38. Chione multicostata Sby.

James Island, *Albatross*.

39. Chione compta Brod.

Indefatigable Island, *Albatross*.

40. Chione undatella Sby.

James Island, *Albatross*.

Subfamily TAPESINÆ.

Genus **TAPES** Megerle.

41. Tapes grata Say.

Indefatigable Island, *Albatross*.

Suborder TELLINACEA.

Family PETRICOLIDÆ.

Genus **PETRICOLA** Lamarck.

42. Petricola amygdalina Sby.

Galapagos Islands, Carpenter.

Family TELLINIDÆ.

Genus **LUTRICOLA** Blainville.

43. Lutricola excavata Sby.

=*L. alta* Conrad.

Chatham Island, Jones; Indefatigable Island, *Albatross*.

Family SEMELIDÆ.

Genus **SEMELE** Schumacher.

44. Semele rupium Sby.

Hood Island, Carpenter.

45. Semele punctatum Sby.

Galapagos Islands, Carpenter.

Suborder MACTRACEA.

Family MACTRIDÆ.

Genus **MACTRA** Linné.

46. Mactra velata Phil.

Chatham Island, Jones.

Order ANOMALODESMACEA.

Suborder ANATINACEA.

Family VERTICORDIIDÆ.

Genus **VERTICORDIA** Wood.

47. Verticordia perplicata Dall.

Off Galapagos Islands, 812 fathoms, *Albatross*.

Suborder ENSIPHONACEA.

Family GASTROCHÆNIDÆ.

Genus **GASTROCHÆNA** Spengler.

48. Gastrochæna regulosa Sby.

Galapagos Islands, Carpenter.

49. Gastrochæna brevis Sby.

Galapagos Islands, Carpenter.

50. Gastrochæna hyalina Sby.

Galapagos Islands, Carpenter.

Suborder ADESMACEA.

Family PHOLADIDÆ.

Genus **PHOLAS** Linné.

51. Pholas acuminata Sby.

?=*Parapholas acuminata.*

Chatham Island, Jones.

Class SCAPHOPODA.

Order SOLENOCONCHA.

Family DENTALIIDÆ.

Genus **DENTALIUM** Linné.

52. Dentalium megathyris Dall.

Off the Galapagos Islands in 812 fathoms, *Albatross*.

Class GASTROPODA.

Subclass ANISOPLEURA.

Superorder EUTHYNEURA.

Order OPISTHOBRANCHIATA.

Suborder TECTIBRANCHIATA.

Family ACTÆONIDÆ.

Genus **ACTEON** Montfort.

53. Actæon perconicus Dall.

Near the Galapagos in 812 fathoms, *Albatross*.

Family SCAPHANDRIDÆ.

Genus **SCAPHANDER** Montfort.

54. Scaphander interruptus Dall.

Off the Galapagos Islands in 812 fathoms, *Albatross*.

Family BULLIDÆ.

Genus **BULLA** Linné.

55. Bulla punctulata A. Ad.

Chatham Island, Jones, Hood, and Indefatigable, *Albatross*.

56. Bulla Quoyi Gray.

Galapagos Islands, Carpenter.

57. Bulla rufilabris A. Ad.

Hood and Bindloe Islands, Wimmer; Galapagos Islands, Carpenter.

Order PULMONATA.

Suborder STYLOMMATOPHORA.

Subfamily GEOPHILA.

Family LIMACIDÆ.

Genus **ZONITES** Montfort.

Subgenus **HYALINIA** Ferussac.

58. Zonites (Hyalinia) Bauri Dall.

South Albemarle Island, Baur.

Family BULIMULIDÆ.

Genus **BULIMULUS** Leach.

Section NÆSIOTUS Albers.

59. Bulimulus nux Brod., Sby. (type).

Albemarle Island, *Albatross;* Charles Island, Petrel, Carpenter, Reibisch, *Albatross;* Chatham Island, *Albatross*.

59. " " banded variety.
1 = *ustulatus* Rve., non. Sby.

Charles Island, *Albatross;* Carpenter, Reibisch.

59. " " " Variety intercised sculpture.

Charles Island, *Albatross*.

59. " " " " Ventricose variety.
2 = Reeve's type.

Charles Island, Carpenter.

3 —— var. = *asperatus* Albers.

Charles Island, Reibisch.

4 —— var. = *incrassatus* Pfr.

Charles Island, Reibisch, Galapagos, Carpenter.

5 —— var. *sulcatus* Reib.

Charles Island, Reibisch.

59. * * * * * elongated variety.

Charles Island, *Albatross*.

6 —— ? *verrucosus* Pfr.

Charles Island, Carpenter.

59. * * * * * * Variety with distorted mouth.

Charles Island, *Albatross*.

59. * * * * * * * Variety with crenulated suture.

Charles Island, *Albatross*.

59. * * * * * * * * Variety with sutural nodes.

7 —— = *nuciformis* Petit.

Chatham Island, *Albatross;* Charles Island, Reibisch.

59. * * * * * * * * * Varieties intermediate.

8 —— = *nucula* Pfr.
9 —— + *invalidus* Reib.
10 —— + *venustus* Reib.

Charles Island, Reibisch; Galapagos Island, Carpenter.

60. Bulimulus Jacobi Sby.

James Island, Carpenter; Chatham, *Albatross*.

61. Bulimulus rugulosus Sby. non Rve.

Charles Island, *Albatross*, Carpenter; Chatham Island, Reibisch, Carpenter.

1 —— var. *infuscata* Ancey.
2 —— var. *planospira* Ancey.

Chatham Island, Ancey.

62. Bulimulus eschariferus Sby. non Rve.

Charles Island, Petrel; Chatham, *Albatross*, Carpenter.

1 —— var. *bizonalis* Ancey.
2 —— var. *subconoidalis* Ancey.

63. Bulimulus unifasciatus Sby.

Charles Island, Carpenter, Reibisch, Petrel.

64. **Bulimulus calvus** Sby.

Charles Island, Reibisch; James Island, Carpenter.

65. **Bulimulus amastroides** Ancey.

?=*calvus* var.

66. **Bulimulus Galapaganus** Pfr.

Galapagos Island, Carpenter; Barrington Island, Reibisch.

67. **Bulimulus Darwini** Pfr.

Bindloe Island, Wimmer; Galapagos Islands, Carpenter.

68. **Bulimulus rugiferus** Sby.

James Island, Carpenter.

69. **Bulimulus sculpturatus** Pfr.

Galapagos Islands, Carpenter.

70. **Bulimulus Manini** Pfr.

Galapagos Islands, Carpenter.

71. **Bulimulus ustulatus** Sby., non Rve. nor Reib.

Charles Island, Carpenter.

72. **Bulimulus pallidus** Reib.

Albemarle Island, Reibisch.

73. **Bulimulus cinereus** Reib.

James Island, Reibisch.

74. **Bulimulus ventrosus** Reib.

Barrington Island, Reibisch.

74a. ——— var. *β*. Reib.

Chatham Island, Reibisch.

75. **Bulimulus acutus** Reib.

Chatham Island, Reibisch.

76.* **Bulimulus curtus** Reib.

Chatham Island, Reibisch.

77.* **Bulimulus nudus** Reib.

Charles Island, Reibisch.

78.* **Bulimulus Wolfi** Reib.

Indefatigable Island, Reibisch.

79.* Bulimulus Simrothi Reib.

Albemarle Island, Reibisch.

Section **RHAPHIELLUS**† Pfr.

80. Bulimulus achatinellinus Forbes.

Chatham Island, Carpenter, *Albatross;* Hood Island, Wimmer.

Genus **PYRGUS**.

Section **PLEUROPYRGUS** Martens.

81. Bulimulus chemnitzioides Forbes.

? = *B. lima* Reib.

Chatham Island, Carpenter, *Albatross*, Reibisch.

82. Bulimulus Habeli Stearns = *B.* (*Pleuropyrgus*) *terebra* Reib.

Chatham Island, *Albatross*, Reibisch.

Section **PELECOSTOMA** Reibisch.

83. Bulimulus canaliferus Reib.

Chatham Island, Reibisch.

Family PUPIDÆ.

Genus **PUPA** Draparnaud.

Subgenus **LEUCOCHILA** Martens.

84. Pupa munita Reib.

Albemarle Island, Reibisch.

85. Pupa clausa Reib.

Indefatigable Island, Reibisch.

Family STENOGYRIDÆ.

Genus **STENOGYRA** Shutt.

Subgenus **LEPTINARIA** Beck.

86. Leptinaria chathamensis Dall.

= *Bulimulus* (*Pelecostoma*) *cymatoferus* Reib.

Chatham Island, Baur; Reibisch.

Family SUCCINIIDÆ.

Genus **SUCCINEA** Draparnaud.

87. Succinea Bettii Smith.

var. = *S. Wolfi* Reib., var.

Chatham Island, Reibisch, *Albatross;* Charles Island, Petrel.

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*I have included these (76-79) in my list, although I suspect their validity.

† Used here tentatively as a section of *Bulimulus* Leach non *Buliminus* Ehr.

88. Succinea Wolfi Reib.

Chatham Island, Reibisch.

—— var. *producta* Reib.

Chatham island, Reibisch.

Superfamily DITREMATA.

Family ONCHIDIIDÆ.

Genus **ONCHIDIUM** Cuvier.

89. Onchidium Lesliei Stearns.

(Plate LI, Figs. 2, 3.)

Albemarle and Charles islands, *Albatross*.

Genus **ONCHIDELLA** Gray.

90. Onchidella Steindachneri Semper.

(Plate LI, Figs. 4, 5.)

Charles and Albemarle islands, *Albatross*.

Suborder BASOMMATOPHORA.

Superfamily AKTEOPHILA.

Family AURICULIDÆ.

Genus **AURICULA** Lamarck.

91. Auricula stagnale Petit.

= *Ellobium stagnale* Petit.

Bindloe Island, Wimmer.

Genus **TRALIA** Gray.

Tralia panamensis C. B. Adams.

Hood and Charles islands, Wimmer.

Subfamily MELAMPINÆ.

Genus **PEDIPES** Adanson.

93. Pedipes angulatus C. B. Adams.

Bindloe Island, Wimmer.

Genus **MELAMPUS** Montfort.

94. Melampus trilineatus C. B. Adams.

Hood Island, Wimmer.

Superfamily PETROPHILA.

Family SIPHONARIIDÆ.

Genus **SIPHONARIA** Sowerby.

95. Siphonaria gigas Sby.

Galapagos Islands, Carpenter.

96. Siphonaria scutellum Desh.

=*obliquata* Sby. ?

Galapagos Islands, Carpenter.

Subgenus **WILLIAMIA**, Monterosato.

97. Williamia peltoides Dall.

Hood Island, *Albatross;* Galapagos Islands, National Museum.

Superorder STREPTONEURA.

Order CTENOBRANCHIATA.

Suborder ORTHODONTA.

Superfamily TOXOGLOSSA.

Family TEREBRIDÆ.

Genus **TEREBRA** Bruguiere.

98. Terebra ornata Gray.

Galapagos Islands, Carpenter.

99. Terebra strigata Sby.

Galapagos Islands, Wimmer, Carpenter.

Family CONIDÆ.

Genus **CONUS** Linné.

100. Conus brunneus Wood.

Hood, Duncan, James, and Indefatigable islands, *Albatross;* Galapagos Islands, Carpenter, Wimmer.

100a. Conus brunneus, var. **diademus** Sby.

Hood and James islands, *Albatross;* Galapagos Islands, Carpenter.

100b. Conus brunneus, var. **tiaratus** Brod.

= *coronatus* Dillwyn.

Hood Island, *Albatross*, Wimmer; Bindloe Island, Wimmer; James Island, *Albatross*.

100c. Conus brunneus, var. = **miliaris**, Auct. in error.

Hood and Duncan islands, *Albatross*.

100d. Conus minimus, var.

? = *brunneus*, var.

Galapagos Islands, Carpenter.

100e. Conus varius, var.

? = *brunneus*, var.

Galapagos Islands, Carpenter.

101. Conus purpurascens, Brod.

Hood, James, and Indefatigable islands, *Albatross;* Galapagos Islands, Carpenter.

101a. Conus purpurascens, var.

=*regalitatus* Sby.

Hood, Charles, James, and Indefatigable islands, *Albatross;* Galapagos Islands, Wimmer.

101b. Conus purpurascens, var.

= *C. Luzonicus* Sby, var.

Galapagos Islands, Carpenter.

102. Conus nux Brod.

Hood Island, *Albatross*, Wimmer; Charles Island, Petrel, Wimmer; Bindloe Island, Wimmer; James Island, *Albatross;* Chatham Island, Jones; Galapagos Islands, Carpenter.

103. Conus lucidus Mawe.

= *C. reticulatus* Sby.

Hood and James islands, *Albatross;* Chatham, Jones; Galapagos, National Museum.

104. Conus pyriformus Reeve.

Hood Island, *Albatross*.

105. Conus gladiator Brod.

James Island, *Albatross*.

106. Conus Fergusoni Sby.

James and Indefatigable islands, *Albatross*.

Family PLEUROTOMIDÆ.

Genus **PLEUROTOMA** Lamarck.

Subgenus **PLEUROTOMA** ss.

107. Pleurotoma exulans Dall.

Off Galapagos Islands, 812 fathoms, *Albatross*.

Genus **DRILLIA** Gray.

108. Drillia excentrica Sby.

Galapagos Islands, Carpenter.

109. Drillia bicolor Sby.

Galapagos Islands, Carpenter.

110. Drillia rugifera Sby.

Galapagos Islands, Carpenter.

111. Drillia albicostata Sby.

Galapagos Islands, Carpenter.

112. Drillia splendidula Sby.

Galapagos Islands, Carpenter.

Genus **MANGILIA** Risso.

Subgenus **CITHARA** Schumacher.

113. Cithara densistriata Cpr.

Chatham Island, *Albatross.*

114. Cithara oryza Hinds.

Bindloe Island, Wimmer.

Subgenus **DAPHNELLA** Hinds.

115. Daphnella sp., **? =casta** Hinds.

Indefatigable Island, *Albatross.*

Subgenus **CALLIOTECTUM** Dall.

116. Calliotectum vernicosum Dall.

Off Galapagos Islands, 812 fathoms, *Albatross.*

Subgenus **PLEUROTOMELLA** Verrill.

117. Pleurotomella argeta Dall.

Off Galapagos Islands, 812 fathoms, *Albatross.*

118. Pleurotomella suffusa Dall.

Off Galapagos Islands, 812 fathoms, *Albatross.*

Section **GYMNOBELA** Verrill.

119. Pleurotomella agonia Dall.

Off Galapagos Islands, 812 and 634 fathoms, *Albatross.*

Family CANCELLARIDÆ.

Genus **CANCELLARIA** Lamarck.

120. Cancellaria mitriformis Sby.

Galapagos Islands, Carpenter.

121. Cancellaria hæmastoma Sby.

Galapagos Islands, Carpenter.

122. Cancellaria ? chrysostoma Sby.

Galapagos Islands, Carpenter, National Museum.

Superfamily RHACIGLOSSA.

Family OLIVIDÆ.

Genus **OLIVA** Bruguiere.

123. Oliva peruviana Lamarck.

Chatham Island, Jones.

124. Oliva kaleontina Duclos.

Galapagos Islands, Carpenter.

Genus **OLIVELLA** Swainson.

125. Olivella ? gracilis Gray.

Chatham Island, *Albatross*.

Family MARGINELLIDÆ.

Genus **MARGINELLA** Lamarck.

Section VOLVARINA Hinds.

126. Volvarina varia Sby.

Galapagos Islands, Wimmer.

127. Volvarina rubella C. B. Adams.

Bindloe Island, Wimmer.

Subgenus **PERSICULA** Schumacher.

128. Persicula imbricata Hinds.

Indefatigable Island, *Albatross*.

129. Persicula phrygia Cpr.

Indefatigable Island, *Albatross*.

Family MITRIDÆ.

Genus **MITRA** Lamarck.

130. Mitra crenata Brod.

Hood Island, Wimmer.

Genus **STRIGATELLA** Swainson.

131. Strigatella effusa Swainson.

James Island, *Albatross;* Hood Island, Wimmer; Galapagos, Carpenter.

132. Strigatella tristis Brod.

Hood, Duncan, and James islands, *Albatross;* Charles Island, Petrel; Galapagos Islands, Carpenter, Wimmer, National Museum.

133. Mitra muricata Swainson.

=*M. lens* Wood.

Galapagos, Carpenter.

Subgenus **COSTELLARIA** Swainson.

134. Costellaria gausapata Rve.

Galapagos Islands, Carpenter.

Subgenus **THALA** H. & A. Adams.

135. Thala gratiosa Rve.

Galapagos Islands, Carpenter.

Family FASCIOLARIIDÆ.

Genus **FASCIOLARIA** Lamarck.

136. Fasciolaria princeps Sby.

James and Indefatigable islands, *Albatross.*

Genus **LATIRUS** Montfort.

137. Latirus ceratus Gray.

Galapagos Islands, Carpenter.

138. Latirus varicosus Reeve.

James Island, *Albatross*; Hood Island, Wimmer; Charles Island, Petrel; Galapagos Island; Carpenter, National Museum.

139. Latirus tuberculatus Sby.

Hood Island, *Albatross*, Wimmer; Charles Island, Petrel; Duncan, James and Indefatigable, *Albatross*; Bindloe Island, Wimmer; Galapagos Islands, Carpenter.

Subfamily FUSINÆ.

Genus **FUSUS** Lamarck.

140. Fusus Dupetithouarsii Kiener.

Chatham Island, Jones; Galapagos Islands, Carpenter.

Family BUCCINIDÆ.

Genus **CHRYSODOMUS** Swainson.

Subgenus **SIPHO** Mörch.

141. Sipho testudinis Dall.

Near the Galapagos Islands, in 812 fathoms.

Genus **PISANIA** Bivona.

Subgenus **TRITONIDEA** Swainson.

142. Tritonidea sanguinolenta Duclos.

= *T. hæmastoma* Gray.

Hood, James, Duncan, Charles, and Indefatigable islands, *Albatross;* Hood and Bindloe Islands, Wimmer; Galapagos Islands, National Museum.

143. Tritonidea cinis Reeve.

Galapagos Islands, Carpenter.

144. Tritonidea biliratum Reeve.

Galapagos Islands, Carpenter.

Genus **ENGINA** Gray.

145. Engina carbonaria Rve.

Hood, Duncan, and James islands, *Albatross;* Galapagos Islands, Carpenter.

145a. Engina carbonaria Rve., var.

= *crocostoma* Rve.

Hood Island, *Albatross;* Charles Island, Petrel; Galapagos Islands, Carpenter, Wimmer.

145b. Engina carbonaria Rve., var.

= *forticostata* Rve.

Hood Island, *Albatross;* Galapagos Islands, Carpenter.

146. Engina pulchra Reeve.

= *Buccinum pulchrum* Reeve.

+ *E. Reeviana* C. B. Adams.

Galapagos Islands, Carpenter.

147. Engina pyrostoma Sby.

Galapagos Islands, Carpenter.

148. Engina maura Sby. ?

Galapagos Islands, Carpenter.

149. Engina zonata Reeve.

Charles Island, Carpenter.

Family NASSIDÆ.

Genus **NASSA** Lamarck.

150. Nassa nodicincta A. Adams.

Charles and Indefatigable islands, *Albatross*.

151. Nassa nodifera Powis.

= *N. tegula* Reeve.

Galapagos Islands, Carpenter.

152. Nassa angulifera A. Ad.

Galapagos Islands, Carpenter.

153. Nassa versicolor C. B. Adams.

Galapagos Islands, Wimmer.

154. Nassa Townsendi Dall.

Near the Galapagos Islands, in 812 fathoms.

Family COLUMBELLIDÆ.

Genus **COLUMBELLA** Lamarck.

155. Columbella castanea Sby.

Hood Island, *Albatross*, Wimmer; Charles and Bindloe islands, Wimmer.

156. Columbella paytensis Lesson.

= *C. spurca* Sby.

Hood and Indefatigable islands, *Albatross*.

157. Columbella fuscata Sby.

Indefatigable, Hood, Chatham, and James islands, *Albatross*; Charles Island, Petrel; Galapagos Islands, Wimmer.

158. Columbella hæmastoma Sby.

Hoods, James, and Indefatigable islands, *Albatross*.

Subgenus **ALIA** H. and A. Adams.

159. Alia unicolor Sby.

Galapagos Islands, Carpenter.

Genus **STROMBINA** Mörch.

160. Strombina bicanalifera Sby.

Galapagos Islands, Carpenter.

161. Strombina lanceolata Kiener.

Galapagos Islands, Carpenter.

Subgenus **NITIDELLA** Swainson.

162. Nitidella incerta Stearns.

Indefatigable Island, *Albatross;* Galapagos Islands, National Museum.

163. Nitidella cribraria Lam.

Hood, Charles, and Bindloe islands, Wimmer.

Subgenus **ANACHIS** A. Adams.

164. Anachis atramentaria Sby.

Chatham Island, Carpenter; Hood Island, Wimmer.

165. Anachis rugulosa Sby.

Hood and Bindloe islands, Wimmer; Galapagos Islands, Carpenter, National Museum.

166. Anachis varians Sby.

Galapagos Islands, Carpenter.

167. Anachis nigricans Sby.

Galapagos Islands, Carpenter.

168. Anachis suffusa Sby.

Bindloe Island, Wimmer.

169. Anachis elegantula Mörch.

= ? *Amycla pulchella* Sby., Wimmer.

Bindloe Island, Wimmer.

Genus **AMYCLA** H. and A. Adams.

170. Amycla sp.

Bindloe Island, Wimmer.

Family MURICIDÆ.

Genus **MUREX** Linné.

Subgenus **PHYLLONOTUS** Swainson.

171. Phyllonotus regius Swainson.

Galapagos Islands, Wimmer.

172. Phyllonotus princeps Brod.

James, Charles, and Indefatigable islands, *Albatross.*

Genus **TROPHON** Montfort.

173. Trophon ? xanthostoma Brod.

= *T. peruvianus* Lesson.

Hood Island, *Albatross.*

Genus **OCINEBRA** Leach.

174. Ocinebra pumilus A. Ad.

Galapagos Islands, Carpenter.

Genus **VITULARIA** Swainson.

175. Vitularia salebrosa King.

Galapagos Islands, Carpenter.

Subfamily PURPURINÆ.

176. Purpura patula Linné.

James, Indefatigable, and Hood islands, *Albatross;* Charles Island, Petrel; Chatham Island, Jones; Galapagos Islands, Carpenter.

Subgenus **PURPURELLA** Dall.

177. Purpura columellaris Lamarck.

Hood, James, Charles, Duncan, Chatham, and Indefatigable islands, *Albatross;* Hood, Charles, and Bindloe islands, Wimmer; Charles Island, *Petrel;* Galapagos Islands, Carpenter.

Subgenus **PLANITHAÍS** Bayle.

178. Purpura planospira Lamarck.

Hood Island, Wimmer, *Albatross*; James and Indefatigable islands, *Albatross;* Galapagos Islands, Carpenter.

Subgenus **THALESSA** H. & A. Ad.

179. Purpura melo Duclos.

James, Duncan, Hood, and Indefatigable islands, *Albatross;* Charles Island, Wimmer; Chatham Island, Jones; Galapagos Islands, National Museum.

180. Purpura callaöensis Gray.

= *Coralliophila callaöensis* Auct.

Charles Island, Petrel, *Albatross.*

181. Purpura triangularis Blve.

= *P. Carolensis* Reeve.

Charles Island, Carpenter.

182. Purpura nucleus Brod.

Galapagos Islands, Carpenter.

Genus **CONCHOLEPAS** Swainson.

183. Concholepas peruvianas Lamarck.

Hood Island, Wimmer.

Genus **MONOCEROS** Lamarck.

= *Acanthina* Waldheim.

184. Monoceros grande Gray.

Hood Island, Wimmer; James and Indefatigable islands, *Albatross;* Galapagos Islands, Carpenter; National Museum.

185. Monoceros tuberculatum Gray.

Chatham Island, Jones.

Subfamily CORALLIOPHILINÆ.

Genus **CORALLIOPHILA** Adams.

Subgenus **RHIZOCHILUS** Steenstrup.

186. Rhizochilus parvus Smith.

Hood Island, Wimmer; Charles Island, Petrel.

187. Rhizochilus madreporarum Sby.

Hood Island, Wimmer.

Suborder **STREPTODONTA.**

Superfamily **PTENOGLOSSA.**

Genus **SCALA** Humphrey.

188. Scala pompholyx Dall.

"Near the Galapagos" in 812 fathoms.

Section **CIRSOTREMA** Mörch.

189. Cirsotrema diadema Sby.

Hood Island, Wimmer; Galapagos Islands, Carpenter.

Family JANTHINIDÆ.

Genus **JANTHINA** Lamarck.

190. Janthina fragilis Lamarck.

=*J. striatula* Cpr.

Chatham Island, Jones; Galapagos Islands, Wimmer.

Superfamily GYMNOGLOSSA.

Family EULIMIDÆ.

Genus **EULIMA** Risso.

191. Eulima micans Cpr.

Bindloe Island, Wimmer.

Genus **STILIFER** Brod.

192. Stilifer astericola Brod. and Sby.

Galapagos Islands, Carpenter, Wimmer.

Superfamily TÆNIOGLOSSA.

Family TRITONIIDÆ.

Genus **TRITONIUM** Cuvier.

Section **COLUBRARIA** Schumacher.

193. Triton Sowerbyi Reeve.

Indefatigable Island, *Albatross;* Galapagos Islands, Carpenter.

194. Triton reticulatus Blve.

Galapagos Islands, Carpenter.

Subgenus **LAMPUSIA** Schumacher.

195. Triton olearium Linné.

Indefatigable Island, *Albatross.*

196. Triton clandestinus Lam.

Galapagos Islands, Carpenter.

197. Triton vestitus Hinds.

Galapagos Islands, Wimmer.

198. Triton lineatus Brod.

Galapagos Islands, Cuming-Reeve (6 fathoms).

199. Triton pictus Reeve.

Galapagos Islands, Carpenter.

Family CASSIDIDÆ.

Genus **CASSIS** Lamarck.

Subgenus **CYPRÆCASSIS** Stutchbury.

200. Cypræcassis tenuis Gray.

James, Charles, Hood, and Indefatigable islands, *Albatross;* Galapagos, Carpenter, Wimmer.

Subgenus **LEVENIA** Gray.

201. Levenia coarctatus Sby.

Galapagos Islands, Carpenter.

Family DOLIIDÆ.

Genus **DOLIUM** Lamarck.

Subgenus **MALEA** Valenciennes.

202. Malea ringens Swainson.

Galapagos Islands, Wimmer.

Genus **ONISCIDIA** Swainson.

203. Oniscidia tuberculosa Reeve.

James, Hood, and Indefatigable islands, *Albatross;* Hood Island, Wimmer; Chatham Island, Jones; Galapagos Islands, Carpenter.

204. Oniscidia xanthostoma A. Ad.

Galapagos Islands, Carpenter.

Family CYPRÆIDÆ.

Genus **CYPRÆA** Linné.

205. Cypræa exanthema Linné.

Var. = *C. cervinetta* Kiener.

James and Indefatigable islands, *Albatross;* Galapagos Islands, Wimmer.

Subgenus **LUPONIA** Gray.

206. Luponia nigropunctata Gray.

James, Hood, and Indefatigable islands, *Albatross;* Hood and Bindloe islands, Wimmer; Galapagos Islands, Carpenter; National Museum.

207. Luponia albuginosa Mawe.

James Island, *Albatross;* Charles Island, Wimmer.

Genus **TRIVIA** Gray.

208. Trivia pacifica Gray.

Hood Island, *Albatross;* Hood, Charles, and Bindloe islands, Wimmer; Galapagos Island, Carpenter; National Museum.

209. Trivia pulla Gaskoin.

Charles and Bindloe islands, Wimmer; Galapagos Islands, Carpenter.

210. Trivia fusca Gray.

Galapagos Islands, Carpenter.

211. Trivia radians Lamarck.

Galapagos Islands, Carpenter.

212. Trivia suffusa Gray.

Galapagos Islands, Carpenter.

213. Trivia sanguinea Gray.

Galapagos Islands, National Museum.

214. Trivia rubescens Gray.

Galapagos Islands, Carpenter.

215. Trivia Maugeræ Gray.

Bindloe Island, Wimmer.

Family STROMBIDÆ.

Genus **STROMBUS** Linné.

216. Strombus granulatus Swainson.

Galapagos Islands, Carpenter.

Family TRIFORIDÆ.

Genus **TRIFORIS** Deshayes.

217. Triforis alternatus C. B. Adams.

Hood Island, Wimmer.

Family CERITHIOPSIDÆ.

Genus **CERITHIOPSIS** Forbes and Hanley.

218. Cerithiopsis neglecta C. B. Adams.

Indefatigable Island, *Albatross*.

Family CERITHIIDÆ.

Genus **CERITHIUM** Bruguière.

219. Cerithium ocellatum Brug.

Galapagos Islands, Carpenter.

220. Cerithium galapaginus Sby.

=*C. interruptum* Mke., var.

Galapagos Islands, Carpenter.

221. Cerithium maculosum Kiener.

=*C. nebulosum* Sby.

Hood, Duncan, James, and Indefatigable islands, *Albatross;* Charles Island, Petrel, Chatham Islands, Jones, Galapagos Islands, National Museum, Carpenter.

221a. Cerithium maculosum Kiener.

var. = *C. adustum,* Kiener.

Hood and Charles islands, Wimmer; Duncan, James, and Indefatigable islands, *Albatross;* Galapagos Islands, National Museum.

Family MODULIDÆ.

Genus **MODULUS** Gray.

222. Modulus cerodes A. Ad.

Hood Island, *Albatross.*

Family PLANAXIDÆ.

Genus **PLANAXIS** Lamarck.

223. Planaxis planicostata Sby.

Galapagos Islands, Carpenter.

Family VERMETIDÆ.

Genus **SIPHONIUM** Mörch.

224. Siphonium margaritarum Val.

Hood Island, Wimmer.

Genus **VERMETUS** Mörch.

Subgenus **SERPULORBIS** Sasse.

225. Serpulorbis squamigerus Cpr.

Hood, James, and Indefatigable islands, *Albatross;* Galapagos Islands, Wimmer.

226. Serpulorbis pellucidus Brod.

Hood Island, Wimmer.

227. Serpulorbis pellucidus Brod.

Var. *planorboides* = *Serpula regularis* Chem.

Hood Island, Wimmer.

Subgenus **ALETES** Carpenter.

228. Aletes sp.

Hood Island, *Albatross.*

Family LITTORINIDÆ.

Genus **LITTORINA** Férussac.

229. Littorina porcata Phil.

Galapagos Islands, Carpenter.

230. Littorina peruviana Lam.

Galapagos Islands, National Museum.

Genus **LACUNA** Turton.

231. Lacuna porrecta Cpr.

Hood and Bindloe islands, Wimmer.

Genus **TECTARIUS** Valenciennes.

232. Tectarius lemniscatus Phil.

= *Hamus lemniscatus.*

Hood Island, Wimmer.

233. Tectarius trochoides Gray.

=*Hamus trochoides.*

Bindloe Island, Wimmer.

234. Tectarius galapagiensis Stearns.

Jan es Island, *Albatross.*

Family RISSOIDÆ.

Genus **RISSOA** Frémenville.

Subgenus **ALVANIA** Risso.

235. Alvania æquisculpta Cpr.

Indefatigable Island, *Albatross.*

236. Alvania reticulata Cpr.

Indefatigable Island, *Albatross.*

237. Alvania sp.

Bindloe Island, Wimmer.

Genus **RISSOINA** Orbigny.

238. Rissoina fortis C. B. Adams.

Hood Island, *Albatross;* Bindloe Island, Wimmer.

239. Rissoina inca C. B. Adams.

Hood Island, Wimmer; Galapagos Islands, National Museum.

240. Rissoina stricta Mke.

Galapagos Islands, National Museum.

Family CALYPTRÆIDÆ.

Genus **MITRULARIA** Schumacher.

241. Mitrularia cepacea Brod.

=*Calyptræa cepacea* Auct.

Chatham Island, *Albatross.*

242. Mitrularia corrugata Brod.

=*Calyptræa corrugata* Auct.

James Island, *Albatross*.

243. Mitrularia varia Brod.

Hood, Charles, and Bindloe islands, Wimmer; Galapagos Islands, Carpenter.

243a. Mitrularia sp.

=*Calyptræa* sp.

Charles Island, Petrel (probably belongs to one of the preceding).

Genus **CRUCIBULUM** Schumacher.

244. Crucibulum imbricatum Brod.

James Island, *Albatross*.

245. Crucibulum spinosum Sby.

Chatham Island, Jones.

Genus **CREPIDULA** Lamarck.

246. Crepidula aculeata Gmelin.

Indefatigable and Hood Islands, *Albatross*.

Genus **TROCHATELLA** Lesson.

247. Trochatella radians Lamarck.

Galapagos Islands, National Museum.

Family AMALTHEIDÆ.

Genus **AMALTHEA** Schumacher.

248. Amalthea Grayana Menke.

Hood, Chatham, and Indefatigable islands, *Albatross;* Hood, Charles, and Bindloe islands, Wimmer; Galapagos Islands, Carpenter.

248a. Amalthea Grayana Mke. variety.

Charles Island, Petrel.

249. Amalthea antiquata Linné.

Hood Island, Wimmer; Chatham Island, Jones; Indefatigable Island, *Albatross*.

250. Amalthea barbata Sby.

Chatham, Jones, Indefatigable, and Hood islands, *Albatross;* Chatham Island, Jones; Galapagos Islands, Carpenter.

251. Amalthea ? subrufa Sby.

Galapagos Islands, Wimmer.

Family NATICIDÆ.

Genus **NATICA** Lamarck.

252. Natica maroccana Chemnitz.

Galapagos Islands, Carpenter.

Genus **POLYNICES** Montfort.

253. Polynices dubia Recluz.

= *N. atacamensis* Phil.

Indefatigable Island, *Albatross*.

254. Polynices uber Valenciennes.

+ *uberina* Orb. + *Phillipiana* Nyst.

Hood, Charles, and Indefatigable islands, *Albatross;* Hood and Bindloe islands, Wimmer.

Subgenus **LUNATIA** Gray.

255. Lunatia otis Brod.

Indefatigable Island, *Albatross;* Hood Island, Wimmer; Galapagos Islands, Carpenter.

Genus **Sigaretus** Lamarck.

256. Sigaretus pellucidus Reeve.

Charles Island, Wimmer.

Family LAMELLARIIDÆ.

Genus **Lamellaria** Montague.

257. Lamellaria Stearnsii Dall.

Hood Island, *Albatross*.

258. Lamellaria ? rhombica Dall.

Hood Island, *Albatross*.

Superfamily DOCOGLOSSA.

Family ACMÆIDÆ.

Genus **ACMÆA** Eschscholtz.

259. Acmæa scutum Orb.

Hood and Indefatigable islands, *Albatross;* Chatham Island, Jones.

260. Acmæa striata Reeve.

Hood Island, *Albatross*; Galapagos Islands, Carpenter.

261. Acmæa patina. Esch.

Hood, Charles and Bindloe islands, Wimmer.

262. Acmæa spectrum Nutt.—Reeve.

Bindloe Island, Wimmer.

Subgenus **NACELLA** Schumacher.

263. Nacella subspiralis Cpr.

Charles and Hood islands, Wimmer.

Superfamily **RHIPIDOGLOSSA**.

Family TURBINIDÆ.

Genus **TURBO** Linné.

Section **SENECTUS** Swainson.

264. Turbo squamigerus Reeve.

Galapagos Islands, Carpenter.

Family TROCHIDÆ.

Genus **OMPHALIUS** Philippi.

265. Omphalius Cooksoni Smith.

? = *O. fasciatus* Born.

James Island, *Albatross*; Hood, Charles, and Bindloe islands, Wimmer; Charles Island, Petrel.

266. Omphalius reticulatus Wood.

Hood Island, Wimmer.

Genus **GAZA** Watson.

267. Gaza Rathbuni Dall.

Off the Galapagos, in 392 fathoms.

Family NERITIDÆ.

Genus **NERITA** Bruguieré.

268. Nerita scabricosta Lam.

= *N. ornata* Sby.

Hood, James, and Indefatigable islands, *Albatross;* Galapagos Islands, Wimmer.

269. Nerita Bernhardi Recluz.

Hood Island, Wimmer.

Family HELICINIDÆ.

Genus **HELICINA** Lamarck.

Section **IDESA**.

270. Helicina nesiotica Dall.

= *H. Wolfii* Rieb.

Chatham Island, Baur, Reibisch.

Superfamily ZYGOBRANCHIATA.

Family HALIOTIDÆ.

271. Haliotis Pourtalesii Dall.

Near Charles Island, in 33 fathoms, *Albatross.*

Family FISSURELLIDÆ.

Genus FISSURELLA Bruguiere.

272. Fissurella mutabilis Sby.

Galapagos Islands, Carpenter.

273. Fissurella rugosa Sby.

Hood, Duncan, Chatham, James, and Indefatigable Islands, *Albatross;* Galapagos Islands, Carpenter; National Museum.

274. Fissurella macrotrema Sby.

Indefatigable Island, *Albatross;* Hood, Charles, and Bindloe Islands, Wimmer; Galapagos Islands, Carpenter.

275. Fissurella crassa Lam.

Galapagos Islands, National Museum.

276. Fissurella obscura Sby.

?=*F. rugosa* Sby., variety.

Hood, Charles, and Bindloe Islands, Wimmer; Charles Island, Petrel; Chatham Island, *Albatross;* Galapagos Islands, Carpenter.

277. Fissurella nigrocincta Cpr.

Galapagos Islands, National Museum.

278. Fissurella virescens Sby.

Chatham Island, *Albatross;* Jones.

278a. Fissurella nigropunctata Sby.

=*F. virescens Sby.*, var.

Chatham Island, *Albatross;* Galapagos Islands, Carpenter.

Genus FISSURIDEA Swainson.

=*Glyphis* Carpenter non Agassiz.

279. Fissuridea inæqualis Sby.

Hood, Chatham, and Indefatigable islands, *Albatross*; Hood, Charles, and Bindloe islands, Wimmer; Galapagos Islands, Carpenter.

279a. Fissuridea inæqualis Sby.

Var.=*F. pica* Sby.

Indefatigable Island, *Albatross*; Galapagos Islands, National Museum.

280. Fissuridea saturnalis Cpr.

Chatham Island, *Albatross.*

281. Fissuridea alta C. B. Ad.

Bindloe Island, Wimmer.

282. Fissuridea mus Reeve.

Bindloe Island, Wimmer.

Subclass ISOPLEURA.

Order POLYPLACOPHORA.*

Superfamily EOCHITONIA.

Family ISCHNOCHITONIDÆ.

Genus **CHÆTOPLEURA** Shuttleworth.

283. Chætopleura janeirensis Gray.

Galapagos Islands, Wimmer.

Genus **CHITON** Linné.

Section **RADSIA** Gray.

284. Chiton (Radsia) sulcatus Wood.

Hoods, Charles, and Indefatigable islands, *Albatross;* Hood Island, Wimmer; Charles Island, Petrel; Galapagos Islands, Carpenter, National Museum.

285. Chiton (Radsia) Goodalli Brod.

Albemarle, Chatham, and Indefatigable islands, *Albatross;* Charles Island, Petrel; Galapagos Islands, Carpenter, Wimmer, National Museum.

Genus **TONICIA** Gray.

286. Tonicia ? Coquimbensis Frembley.

Galapagos Islands, National Museum.

287. ? Tonicia hirundiformis Sby.

Galapagos Islands, Carpenter, Wimmer.

Superfamily OPSICHITONIA.

Family MOPALIIDÆ.

Genus **ACANTHOCHITON** Leach.

288. Acanthochiton spinifera Frembley.

= *C. aculeatus* Barnes.

Galapagos Islands, National Museum.

* The proper classification of the *Chitons* herein listed awaits the publication of Mr. Pilsbry's Monograph.

The total number of species in the foregoing list embraces 288, and the varieties number 30, all together 318, which may be segregated as follows:

	Species.	Varieties.
Pelecypods, marine	61	....
Scaphopods, marine	1	....
Gastropods, marine	205	13
Gastropods, land	31	17
Total	288	30

Of the 288 species 59 were detected for the first time by the *Albatross* party; of these 12 are deep water forms obtained by dredging, and not previously described; these are included in "Dalls List." Of the shallower water forms two are new and have been described by me elsewhere; also one new and interesting species of land shell. Many of the varietal forms I regard as synonyms or of doubtful validity; whatever may be their value, all or nearly all were obtained by the *Albatross* party, as may be seen by reference to the text.

Acknowledgments are due to Hon. Marshall McDonald, U. S. Fish Commissioner, for the use of the drawing from which the map accompanying this paper has been reproduced, and to Dr. W. H. Dall, who kindly assisted in the correction and revision of the proofs.

PLATE LI.

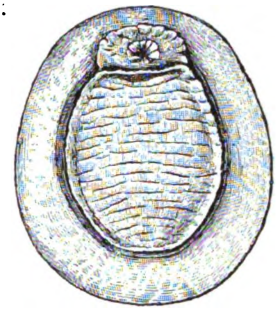
NOTE.—The numbers following the authority of the specific name denote the actual size of the specimen figured, in millimeters.

Fig. 1. *Bulimulus (Pleuropyrgus) Habeli* length, 17.5; breadth, 3.5; p. 382.
2. *Onchidium Lesliei,* dorsal view; length, 37.5; breadth, 31.5; p. 383.
3. *Onchidium Lesliei,* ventral view.
4. *Onchidella Steindachneri,* dorsal view; length, 20.0; breadth, 17.0; p. 384.
5. *Onchidella Steindachneri,* ventral view.
6. *Nitidella incerta,* length, 6.02; breadth, 2.75; p. 390.
7. *Tectarius galapagiensis,* length, 7.50; breadth, 5.0; p. 397.

PLATE LII.

MAP OF GALAPAGOS ISLANDS.

2



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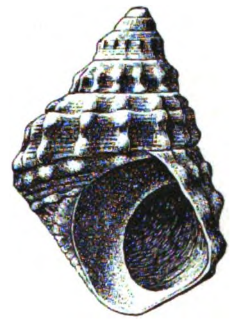
6

1



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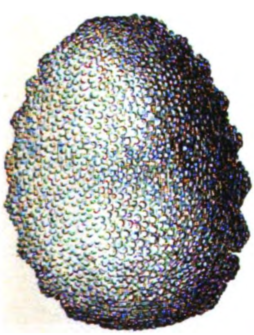

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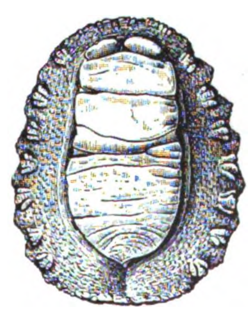
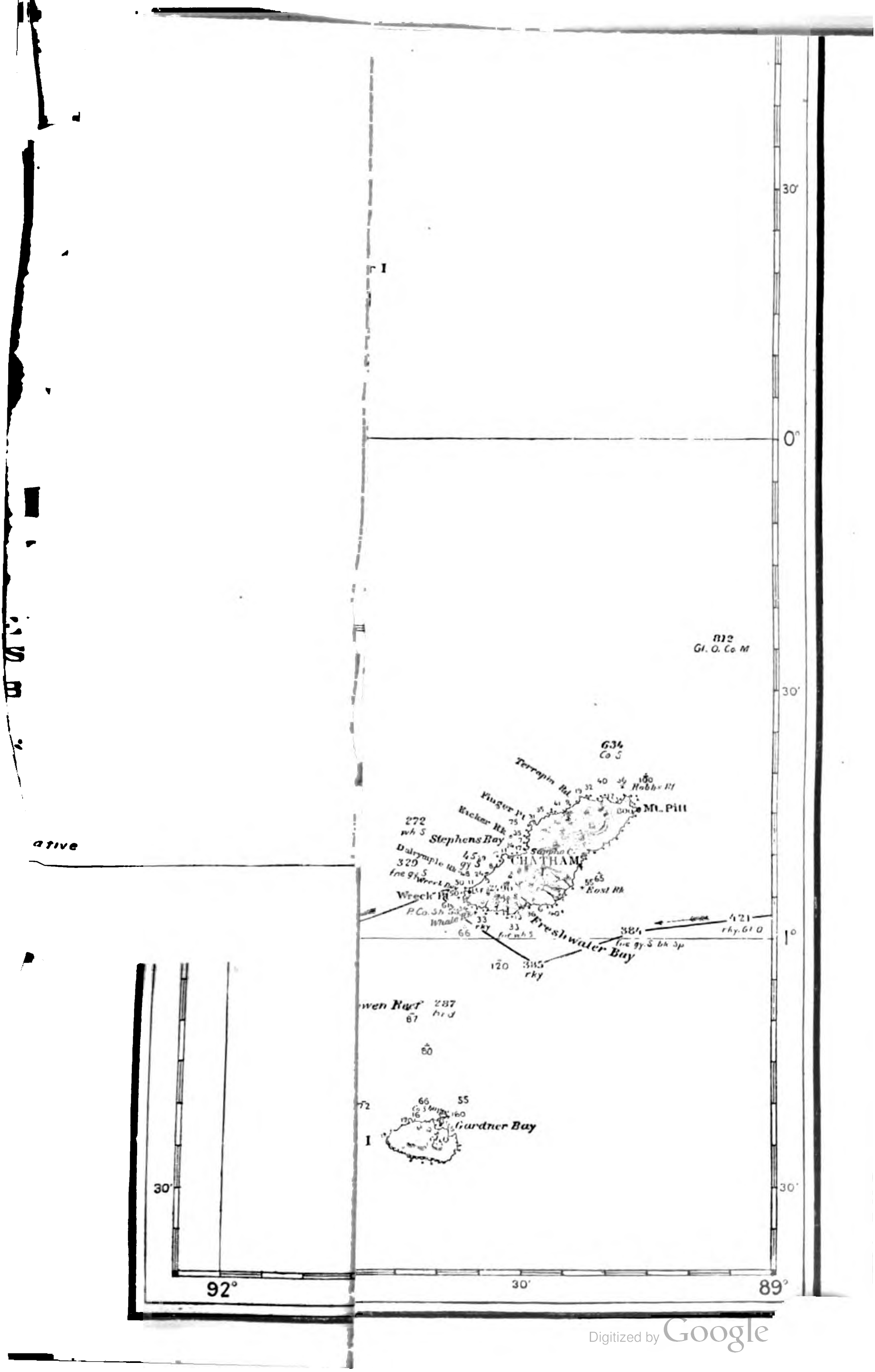
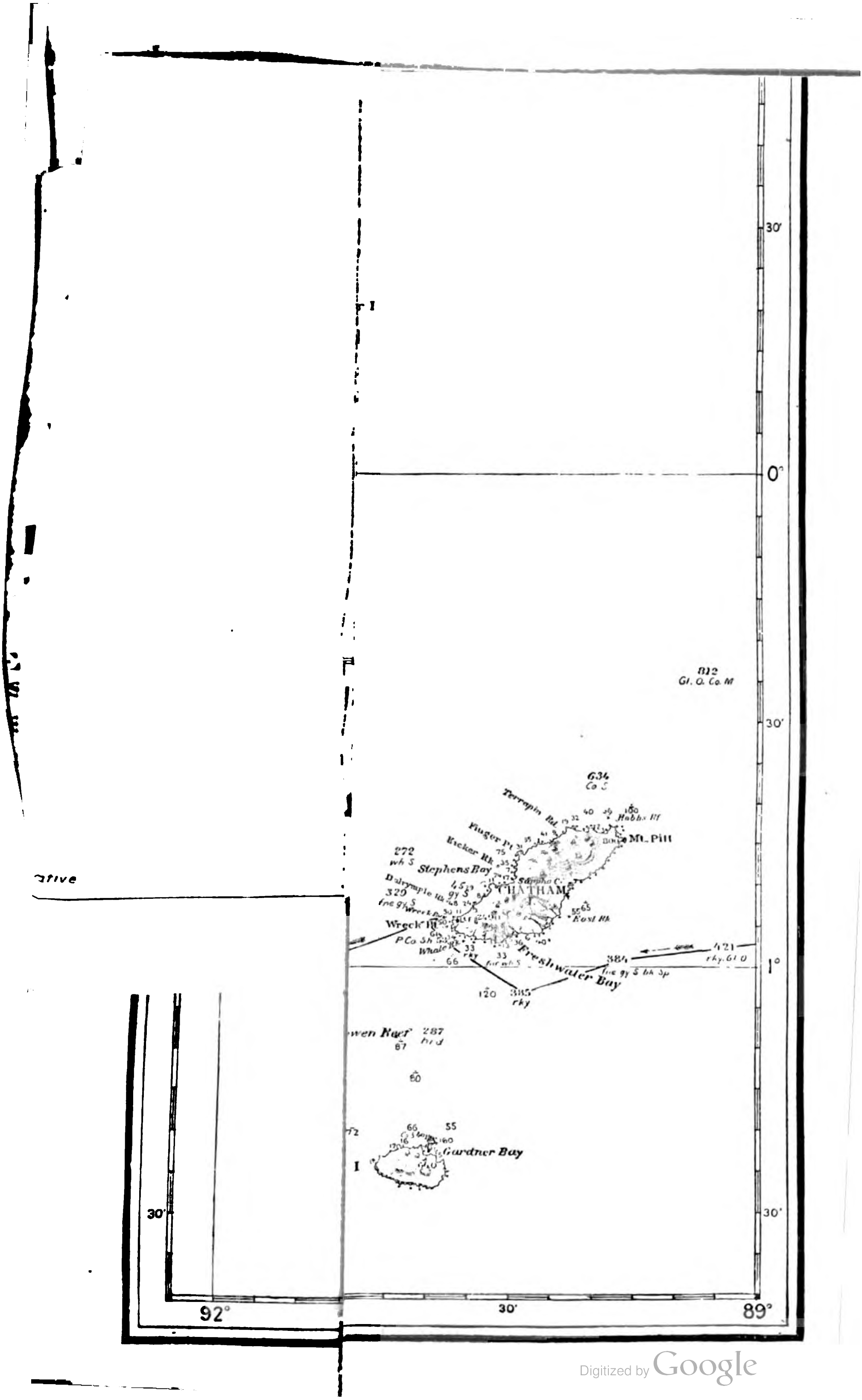


5

MOLLUSKS OF THE GALAPAGOS ISLANDS.



30'
0°
812
Gl. O. Co. M
30'
634
Co S
Terrapin Rd
Hobbs Pt
Mt. Pitt
Finger Pt
Kicker Rk
272
wh S
Stephens Bay
Dalrymple Rk
329
CHATHAM
East Rk
Wreck Pt
Whale Rk
Freshwater Bay
421
rky. Gt O
384
1°
120
385
rky
287
Gardner Bay
30'
92°
30'
89°


30'
0°
812
Gl. O. Co. M
30'
634
Co S
Terrapin Rd
Finger Pt
Kicker Rk
Stephens Bay
Dalrymple Rk
Mt. Pitt
CHATHAM
East Rk
Hobbs Rf
Wreck Pt
Whale Rk
Freshwater Bay
1°
Gardner Bay
30'
92°
30'
89°

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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No. XXVI.—REPORT ON THE PTEROPODS AND HETEROPODS COLLECTED BY THE U. S. FISH COMMISSION STEAMER ALBATROSS DURING THE VOYAGE FROM NORFOLK, VA., TO SAN FRANCISCO, CAL., 1887-'88.

BY

JAMES I. PECK.

(With Plates LIII-LV.)

I.—THE THECOSOMATOUS PTEROPODS.

In the course of the steamer *Albatross*, south from Norfolk, representatives of this group of the Mollusca were dredged at a series of seven stations, off the West Indies Islands and along the eastern coast of South America, as follows:

Sta.	Lat.	Long.	Depth.	Temp.	Character of bottom.	Date.
	° ′	° ′ ″	*Fath.*	°F.		1887.
2750	18 30 N.	63 31 00 W.	496	44.5	fine gray sand	Nov. 27
2751	16 54 N.	63 12 00 W.	687	40.0	blue glob. ooze	Nov. 28
2754	11 40 N.	58 33 00 W.	880	38.0	glob. ooze	Dec. 5
2756	3 22 S.	37 49 00 W.	417	40.5	gray sand bank	Dec. 14
2760	12 7 S.	37 17 00 W.	1,019	39.5	brown clay (ooze)	Dec. 18
2761	15 39 S.	38 32 54 W.	818	39.0	pteropod ooze	Dec. 26
2763	24 17 S.	42 48 30 W.	671	37.9	brown glob. ooze	Dec. 30

They were also taken in a series of surface collections extending over regions as follows:

Sta.	Lat.	Long.	Temp.	Sea.	Sky.	Date.
	° ′	° ′ ″	°F.			
1	34 13 N.	74 13 30 W.	75	smooth	clear	Nov. 22, 5 p. m.
2	31 16 N.	71 50 00 W.	70	smooth	slightly cloudy	Nov. 23, 6:15 p. m.
16	4 21 S.	81 59 00 W.	74	very smooth	moonlight	Mar. 1, 1888, 4:45 a. m.
19	7 37 N.	78 46 30 W.	78	light swell	hazy	Mar. 3, 2:15 p. m.
26	0 30 N.	88 37 30 W.	80	light swell	light clouds	Apr. 3, 7:35 p. m.
31	0 08 S.	90 06 00 W.	82	smooth	light clouds	Apr. 15, 7:30 p. m.

Of these, it will be seen that they do not in any way coincide with the dredging stations, since only the first two in which live pteropods were taken are located in the Atlantic, off Cape Hatteras, and farther east off northern Florida, while the four others are located in the Pacific, one off Cape Blanco of Peru, one in Bay of Panama, and two east from the Galapagos Islands. The vessel having in the mean time passed around South America into the Pacific, and sailing northward

reached in her course the Galapagos Islands. Hence it is that a comparison of the foregoing tables of stations will show that the empty shells, taken with the dredge, do not conform in locality to the existence of live animals at the surface taken by the two nets. This is partly due to the fact that surface collecting was not always done at the same time and place as the bottom collecting, and even when that was the case the result was the same. In the deep-sea dredgings of the open waters where the pteropods are found, the surface and bottom collections for one station may not agree closely, whereas the averages of the surface and bottom from a number of stations of the same region may agree quite closely. Corresponding to dredging station 2756, only 417 fathoms, the surface net took heteropods but no pteropods; while corresponding to a surface station 7, at which also heteropods only were taken, was a dredging station 2755 in which shells of neither were taken at 720 fathoms. So that from the individual position of the stations no inferences can be drawn as to correlative existence between live pteropoda at the surface and the presence of their dead shells at the bottom, over the same area. Surface collections of pteropods may be present without the occurrence of like shells in collections of deposit at that point, as shown at surface station 26, as also deposit shells may be taken without the corresponding presence of live shells at surface, as at station 2756. But these dredgings would of themselves undoubtedly show that at some seasons of the year and at some zonary depths, if not at the surface, these mollusks exist in greater or less abundance throughout the regions traversed in the course of the *Albatross*

Of the three families of Thecosomatous Pteropoda, Limaciniidæ, Cavoliniidæ, and Cymbuliidæ, the first is represented in these collections only by two live specimens of Limacina inflata, which were taken at station 2754, by the dredge, at a depth of 880 fathoms associated with six different species of Cavoliniidæ, all of which latter, however, were represented only by empty shells. This would agree with Haeckel's statement* that this particular species is one of those belonging to zonary and bathybic faunæ. The temperature at the bottom at this point was 38° F., 46 degrees colder than that recorded for the surface water, amounting almost to arctic temperature.

The Cymbuliidæ are not represented in the collections in any way. The Cavoliniidæ, on the other hand, considering the fact that the collecting points at which they occur are so few, are quite completely represented both at surface and bottom At the dredging stations all the eight species of *Cavolinia*, except one (*globulosa*) the one species of *Cuvierina* (*columella*) and six of the fourteen species of *Clio*, nearly one-half are represented. Cavoliniidæ, in fact, were taken at everyone of the dredging stations as well as at each of the surface stations where any pteropods were taken. Under this family of the eight spe-

* Jenaische Zeitschrift für Naturwissenschaft, Fünf und zwanzigste Bands, p. 277 (Pteropoden und Heteropoden).

cies of the genus *Carolinia*, *uncinata* occurred at two of the dredging stations 2750, 2760, and at one of the surface stations, surface 16. The species *longirostris* was found at two dredging stations 2754, 2760, and two surface stations 26, 31; *tridentata* was taken at four of the dredging stations 2750, 2756, 2760, 2763, but at none of the surface collections; *gibbosa* occurred at two of the dredging stations 2750, 2760, and at one surface station, 19; *trispinosa* was found at four of the dredging stations, 2750, 2751, 2754, 2760, and at one surface station, 2; *inflexa* was taken at two dredging stations 2754, 2760; *quadridentata* occurred once only, as a deposit shell at 2760.

Of the species of *Clio* represented in the collections from these points, *Clio* (*Creseis*) *virgula* has been included in the study, although it was taken at a point farther north in the Gulf Stream (hereafter described). *Clio* (*Creseis*) *conica* was taken at surface station 1; *Clio* (*Hyalocylix*) *striata* was taken at surface station 16; *Clio* (*Styliola*) *subulata* was taken at surface station 1, also at dredging station 2754; *Clio* (*s. str.*) *balantium* was taken at dredging station 2754; *Clio* (*s. str.*) *pyramidata* was taken at dredging stations 2750, 2751, 2760.

Lastly, of the genus *Cuvierina*, the species *columella* was taken at two dredging stations 2754, 2760, and at surface station 2.

Of the data of the distribution of these families here given, results indicate that areas of deposit and the surface habitat of these mollusks in these particular temperate and tropical regions, are rich in Cavoliniidæ, especially so in *Cavolinia*, while *Clio* and *Cuvierina* are very well represented; *Clio* occupying the more northern latitudes in so far as these collections give evidence. Results also show that there are no marked distinctions between the kinds and distribution in the Atlantic and the Pacific waters upon either side of northern South America. The shells in deposit confirm the evidence of the surface collections, so far as there is any evidence from deposits upon the floor of the ocean. As has been said, there is no material dredged from the Pacific side, where surface collections were present, but these latter, from the Pacific, were entirely similar to the relative kind and abundance of the pteropods, both surface material and deposit shells, of the Atlantic side. The few Limacinidæ taken, either as dead shells or in the low temperatures of bathybic collections, were obtained from the deep-water dredgings in the Atlantic.

I have given in Plate I an outline map of the region to which this account applies, reference to which will show the line of transit along which the stations are laid.

Some of the dredging stations are apparently near in-shore for the occurrence of pteropod deposits, but all are drawn in at least 500 fathoms.

After leaving station 2763, the course of the steamer lay south for 26 degrees of latitude in the shallow waters along the eastern coast of South America, the depth ranging only from 10 to about 80 fathoms.

No shells of pteropods are recorded from the dredgings in these waters. Twelve deep-water stations are also recorded along the western coast of South America in the course of the vessel northward through 15 degrees of latitude, the depth ranging from 100 to 1,200 fathoms, but no pteropods are reported.

No dredging stations were made between 38° 08′ south and the equator. In fact, all the other forty-seven dredging stations in the Pacific waters, except nine, were made in shallow waters ranging from 6 to about 75 fathoms; in none of these are pteropods recorded.* But the surface collections secured them, as is shown in the outline map, between the mainland and the Galapagos Islands, as described heretofore in this article for the various genera and species of *Carolinia* and *Clio*. No dredging stations are recorded at exactly these bearings except one at surface 26 in 1,379 fathoms.

I have given thus a sketch of the course of the *Albatross* and the depths and, in some cases, the temperature of the waters traversed, in the hope of arriving at some reasons for the meeting with pteropods in the dredging points in the south temperate zone, upon both eastern and western coasts of the southern part of South America, in the same measure as they are found in the northern parts in the torrid zone. Not belonging to litoral faunæ, we should not expect them in the shallow dredgings along the coast. But some other causes must operate to prevent their occurring in the deeper waters of the more open sea along those coasts; and why, therefore, should they not appear from the deeper dredging stations on the western coast of southern South America? The dredging stations made below latitude 38° were, as has been stated, taken upon the eastern side in shallow waters, but upon the western side in much deeper waters, so that bathybic or zonary faunæ would be very different from that of the shallower seas; the surface temperatures, however, agree very closely. A series of thirteen consecutive stations of the east side below latitude 38° averaged, at surface, 54.3° F. in the latter half of the month of January; a similar consecutive series of thirteen stations in about the same latitude along the west side averaged 55° in the first half of the month of February. But no pteropods are recorded at any surface stations in the Pacific except those indicated upon the outline map in Plate I, while deposit shells were not taken in the Pacific by this expedition.

Thus it falls out that pteropod collections of this voyage are, in origin, for the most part from the Caribean and Panamaic provinces,—that the two regions furnish material entirely similar in make-up—which material belongs almost exclusively to the family Cavoliniidæ, representing all the species except one of the genus *Cavolinia*, the spe-

*See "table of trawling and dredging stations" made by *Albatross* during the year and a half ending June 30, 1888, in the Report of the Work of the U. S. Fish Commission Steamer *Albatross* from January 1, 1887, to June 30, 1888, by Lieut. Commander Z. I. Tanner, U. S. Navy, commanding. Fish Commission Report of 1887."

cies of *Cuvierina*, as also six of the fourteen species of *Clio*, counting, however, *virgula* from farther north; and lastly that from none of the deeper water dredgings in the Pacific are reported deposit shells, although at times dredgings were there taken in the same region with the surface collections which secured them; also that *Limacina* occurred only at considerable depths both alive and as deposit shells.

From the work of the steamer *Blake* Alexander Agassiz concludes that bottom distribution is largely determined by the course of the ocean currents, so that by means of pelagic faunæ and their bottom distribution, light may be thrown upon the course of the currents.* To this cause he ascribes the presence of Arctic pteropods along the New England coast, from the course of the Labrador currents. In this way also an explanation is found why surface collections of pteropods may be abundant over deep waters while the bottom distribution must be looked for elsewhere along the ocean current which sweeps the region; such doubtless is the case with regard to the surface collections of the *Albatross* on this voyage in the Gulf of Panama and at the Galapagos Islands. As has also been stated from the evidence of these collections, forms of *Clio* are more abundant in the more northern stations than representatives of *Carolinia*. If therefore we regard the equatorial seas of the West Indian and Caribbean regions as offering the most favorable conditions for the growth of these pelagic molluscs, it may be readily seen that they would be largely distributed from these areas to the northward upon the surface of the Gulf Stream; while in the new conditions thus encountered the abundance of the *Carolinia* forms might succumb first, and that the species of *Clio* might be enabled to hold their own longer in the struggle and so be carried farther into the temperate waters of the Northern Atlantic.

So also in the distribution of these molluscs south from these equatorial areas named, the Brazil current and the other currents running southward along the coast of South America doubtless carry quantities of pteropod shells far from the habitat of the animals when living before their final deposition upon the bottom; but the bottom accumulations may at the same time be augmented by the shells of the same species borne alive upon the surface of the current until such conditions were entered as to cause their wholesale destruction, producing a comparatively sudden precipitation, as it were, of some of the classes of living organisms as soon as they are swept into the regions in question.

At any rate from these or other causes large deposits of pteropod ooze were encountered by the *Albatross* in her course along the South American waters. Such an ooze was discovered at station 2760, the study of which has some evidence for a distribution of the family *Caroliniidæ* as heretofore outlined; that is to say, the accumulation of mollusc shells upon the floor of the ocean is some evidence of the relative kind and abundance of the molluscan life inhabiting the

*Three cruises of the *Blake*, by Alexander Agassiz. Vol. I, pp. 120–121.

waters above, and, if the greater part of the ooze is made up of Cavoliniidæ deposited through constant and successive seasons in the same region, its composition must bear some relation not only to the pelagic but also to the zonary and bathybic faunæ by which it is laid down in this region.

This "pteropod ooze" in question was dredged in 1,019 fathoms depth, and when dried it proved to be a mass made up almost entirely of pteropod shells in various states of entirety, in which condition it was submitted for study. In order to compare the genera and species, as shown by deposit, with those of the same genera and species taken alive at the surface, the specimen of ooze reported was separated into its component parts and weighed. A comparison by weight, of course, expresses only the amount of material contributed to the general mass of the deposit by each group, and bears no exact relation to the number of individuals in each of the various groups, because of the great difference in individual size; one of the largest, *C. tridentata* for instance, will outweigh many of the small *Clio subulata*; one large *Clio balantium* will contain more material than several of the much smaller *Clio pyramidata*, and yet a table of comparative weights shows very clearly, I think, the relative activity of the sources from which these great deposits are laid down, both as regards individual numbers as well as the mass of material contributed by each kind. Such a table of relative weight of the principal constituents in their order runs thus:

	Grams.	
Carolinia longirostris, tridentata, uncinata, quadridentata	6.477	
Cavolinia inflexa	.084	
Carolinia trispinosa	.500	
Curierina columella	.808	
Clio (s. str.) pyramidata	.861	
Clio (Styliola) subulata	.276	
Total Cavoliniidæ		9.006
Limacinidæ (fragments)	.151	
Limacina inflata	.006	
Total Limacinidæ		.157
Atlanta peronii	.146	
Total Heteropoda		.146
Cyclammina	.170	
Triloculina (?)	.282	
Globigerina (etc.)	.082	
Total Rhizopoda		.534
Débris		7.808
Total oöze		17.651

The species under the genus *Carolinia* were weighed together, because the specific place of so many of the fragments of shells could not be distinguished owing to their fragmentary state, although their place

in this genus was perfectly evident. But by far the greatest number of individuals, and the largest relative weight, belonged to the species *longirostris;* of the total 9.006 grams of *Cavolinia*, 5.513 grams, nearly two-thirds, were from this species. Then come in the order named, *uncinata*, *tridentata*, and *quadridentata*. The material afforded by the Limacinidæ is relatively light, and it is probable that even this estimate of these coiled pteropods was somewhat exaggerated by some fragments of spiral shells (of which only the central spire remained), which belonged to other spiral gastropods than Limacinidæ; although weighed in this connection because they had possibly belonged to characteristic species of this group, Limacina was not even numerically abundant.

The Heteropoda are represented in the ooze only by medium-sized *Atlanta peronii*, which were quite common. The three principal genera of Rhizopoda which characterized this deposit were *Triloculina* (?), *Cyclammina*, and *Globigerina*, with a few *Orbitulina* and *Orbitoides* (?). These forms could easily be separated from the general mass on account of their large size; but there are doubtless others that remain mixed with the fine débris of the sample, which, if they could be separated out, would add somewhat, but not very materially, to the total weight of the Rhizopoda of the ooze. It is worthy of remark that this pteropod ooze was associated with a globigerina ooze, but so stratified as to be quite distinct. This appears from the account of Capt. Tanner,* who describes the trawl as being buried in mud, so as to be landed with difficulty, when the main mud bag of the net was filled with one deposit while the smaller ring nets were filled with a very different one—the deposits being a fine globigerina ooze, "with only here and there a pteropod shell," and a coarse pteropod ooze, but which was uppermost is not stated; the latter is the one here considered.

This débris, finally, is that which remained after all was separated that could be readily identified; it therefore comprises a good deal of very finely ground shells as of some very fine dried silt. But there were also weighed with it other forms of life, such as several kinds of gastropods, two kinds of lamellibranchs, and also small sea-urchin shells in considerable numbers—all the material, in fact, that was not quite plainly pteropod, heteropod, and rhizopod. It is largely made up of triturated shells as the unaided eye may readily determine, which triturated shells, however, represent the scattered remains of *Cavolinia*, *Clio*, *Cuvierina*, *Limacina*, etc., in about the same ratio, I am strongly led to believe, as above given for the rest of the ooze.

Of course there are many sources of error in such a reduction of this sample of ooze; I have no means of judging what of the smaller constituents might not have been taken away in the preparation and

*Report on the work of the U. S. Fish Commission steamer *Albatross* from January 1, 1887, to June 30, 1888, by Lieut. Commander Z. L. Tanner, U. S. Navy.

drying of it, and it is by no means intended that these careful weights imply the mathematical accuracy of a chemical analysis, but I am very certain that they do represent very faithfully the relative proportions of the kinds and abundance of the forms actually living in the surrounding waters, at least as far as the pteropods and heteropods are concerned, because the evidence of the surface collections from regions to the north leads to this same view. At the depth of a thousand fathoms not many, even of the more delicate shells, would be lost immediately by solution; at least they would all disappear at a uniform rate, since the majority of the shells are so nearly alike in thickness and material.

This analysis of the work was entered into with the purpose of getting some check upon the sum total of the work done both at the surface and at other parts of this section of the equatorial Atlantic, and with the result that from the ooze at this point also we draw the same conclusions as to the relative kind and abundance of Cavoliniidæ and Limaciniidæ inhabiting these latitudes upon both sides of the northern part of the South American continent, as were drawn from the comparison of the other dredging and surface collecting stations. The Cavoliniidæ predominate largely, and of these the genus *Cavolinia* is more abundant, although the various subgenera of *Clio* are well represented.

In the sample of pteropod ooze, the species *longirostris* was the most abundant of any individual form, which is also true of the surface collecting, although the *uncinata* is very abundant. Such is accordingly the systematic composition and distribution of the pteropods of this expedition. The mere fact that they are pelagic forms prevents their being divided off into distinct regions, except very broadly speaking, but it is doubtless true that a corresponding number of consecutive collecting points, taken in arctic or even in temperate climates, would produce a series of pteropods agreeing among themselves as these do, but of a different general type which should represent the majority of individuals and species.

Some of the thecosomatous pteropods have been figured many times, showing their anatomy as well as the form of the empty shell, and in the figures upon Plates II and III it is not so much intended to bring out new points in the form of the individual genera or species as to bring together in a series the representative species taken by the *Albatross*, in order that their relative size and homologies may be better indicated, and thus their pelagic association with each other when living the better appreciated. In order to do this, the shells of the various groups are figured, drawn to the same scale—five times enlarged—as showing properly enough many of the points in which the genera of the family Cavoliniidæ stand related to each other, and the species to the genera. The outlines were drawn with an embryograph, showing lateral, ventral, and, in some cases, front views of the shells, in order to obtain the proportions of the organisms with their specific

qualities. The classification was made in accordance with the radical revision of the group as proposed in the Reports of H. M. S. *Challenger*,* and it was the purpose of the figures to arrange the system graphically as far as could be done, for the pteropods of those regions covered by the *Albatross*.

Plate II is devoted to the genus *Cavolinia*, excepting Figure 8, which outlines in different positions shells of the only coiled pteropods taken, specimens of the family Limacinidæ, *Limacina inflata*. It has already been stated that two live specimens were taken at 880 fathoms, and when preserved the parts were withdrawn largely into the large opening of the shell. These minute empty shells were present also in the ooze examined. The other figures on the plates are drawn with ventral face upward, the position usually assumed by the living animal, so that the dorsal part of the shell is below in the side views of outline drawings. Figs. 1–7 present seven of the eight species of the genus *Cavolinia*, the small *globulosa* not having been obtained by these collections. Figs. 1 and 2 represent the species "with dorsal lip thickened into a pad." That is to say, *trispinosa* and *quadridentata*. The thickened dorsal lip—in the drawing represented by the heavy line—is in the living animal deeply brown pigmented, and so contrasts strongly with the translucent color of the rest of the shell. Fig. 1 represents *trispinosa*, *a* from ventral view, *b* from side view, and *c* from front view. The drawing is incomplete with respect to the long, posterior spine (not truthfully represented by the dotted lines of the figure), which bears upon its end the embryonic shell, and relatively is very long, as may be seen in figures of the living specimen.† This figure does show, however, the relative size of this species, its greater lateral extent as compared with its dorso-ventral thickness. In the arrangement of its projecting points, the aperture and various proportions of the parts, *trispinosa* compares with *inflexa* (Fig. 7.), but on account of the thickened dorsal lip it stands in the scheme of classification of the *Challenger* Reports, next to *quadridentata*.

Cavolinia quadridentata is represented in Fig. 2, from *a* ventral view, *b* lateral, and *c* dorsal view. It is the smallest representative of all the species of this genus in the collections, is very much rounded, very compact in shape, with small aperture, and without any lateral or posterior projections to the shell. All the other Cavolinidæ are without the thickened anterior edge of the dorsal lip. Of these *longirostris*—Fig. 6 *a* ventral and *b* lateral view—has a distinguishing feature in the fact that the ventral lip projects beyond the dorsal, so that in *a* the extreme points in the posterior contour of the shell belong to the ventral lip alone, since they project beyond the edge of the dorsal lip, which ends at the two small projections at the hind end of the shell, interior to the other extreme tips, and so nearer the middle line. The

* By Paul Pelseneer, Vol. XXIII of those Reports.

† Rang et Souleyet, Monographie des Ptéropodes, Paris, 1852.

side view of *longirostris* (*b*) shows also the great development of the dorsal (lower in the figure) lip of the shell, prolonged into the long hood which runs far out beneath the overlying fins, and sculptured with the deep notch in its anterior part. This little shell is, in many respects, the most highly developed, as it is also the most abundant in the collections.

C. gibbosa—Fig. 4, *a* ventral, *b* lateral view—is characterized by the prominent transverse keel into which the anterior surface of the ventral lip is developed. This feature appears in lateral view, Fig. 4 *b*, and is evidently due to an accelerated growth of the shell in this part, as is shown by the strong ridges and width between the lines of deposit, giving it a markedly serrated contour at this point. The dorsal (lower in the drawing) lip of this species is also relatively large at its anterior part, forming a deep hood underneath the fins. On these accounts the posterior aspect of gibbosa is comparatively narrower than the anterior part (see *a* of Fig. 4) which is one of the points used in giving it its systematic position.

Fig. 5 shows in outline a representative of the species *tridentata; a* from ventral, *b* from lateral view. All the members of this species taken on this trip of the *Albatross* were quite large, and the one figured was one of the largest specimens; they were not very abundant. It might well be chosen as a typical Cavolinian pteropod shell; none of the parts are exaggerated, all are symmetrically developed. The lateral view *b*, however, imperfectly represents the measure of the dorsal lip of the shell, the anterior hoodlike projection of which was broken off in the specimen figured; in a complete specimen it is more nearly like the same structure in *C. gibbosa* (Fig. 4 *b*), although not quite so well developed.

The two specimens of *Cavolinia* which have the posterior and lateral parts of the shell drawn out into points (but with their anterior margin of dorsal lip) are *uncinata* and *inflexa*. The former of these is represented in Fig. 3 in *a* dorsal and *b* lateral view. The posterior spine of the shell is relatively quite long and strongly curved backwards, while the lateral points of the shell give a considerable increase to the expanse of the aperture between the two lips. The dorsal lip also is very strongly curved and compressed antero-posteriorly, while the ventral lip is very much rounded, showing upon its anterior face the lines of growth of the shell deposit. Finally, Fig. 7 represents the form of *Cavolinia inflexa*, *a* from ventral, and *b* from lateral view. The shell is much more tubular than that of *uncinata*, the lateral points giving width to the aperture of the shell, which does not, however, extend the whole length of the shell, thus leaving a very long curved posterior part. The dorsal lip, moreover, runs straight forward and does not curve up into a hood below the fins, as is more or less the case in the other species.

Such are the relations of these species as indicated in Figs. 1–7. In every case the anterior of the drawings of the shells is toward the right (except the front view in Fig. 1*c*) and the ventral face of the shell

turned uppermost, as when occupied by the living animal. *a* is in each case the outline from the ventral face and *b* from the side, while Fig. 8 represents the species *Limacina inflata*.

The representatives of the genus *Clio* are given upon Plate III. Of these the one species *virgula* (Figs. 9 and 10) was not taken upon this trip of the *Albatross*, but belongs farther north, having been taken abundantly by the Fish Commission Schooner *Grampus* in her investigations of the Gulf Stream, southeast from Marthas Vineyard, at the surface in the summer of 1889. Two forms of it were found—the species *virgula* proper (represented in Fig. 9) from lateral view, also an optical section from front, showing its circular shape, and a variety of the same, *corniformis*, which differs from the former only in the length of the shell, the size of its opening and the curve of the posterior point being relatively about the same.

The one other pteropod taken with shell quite unsculptured and of circular section is *Clio (Creseis) conica*, represented in Fig. 11, which thus shows its straightness in all positions, its great length, and slenderness also as compared with any of the others. In Fig. 12 is represented *Clio* (*Styliola*) *subulata*, which is distinguished from the other straight-shelled pteropods by the possession of a dorsal longitudinal groove which runs somewhat obliquely along the shell out into a projection, which on its account better resists fracture perhaps, or else is a normal feature of the shell. This groove gives a very evident asymmetry to the shell—as if it were the axis of the animal and the posterior part of the shell were bent away from this axis.

In the optical section the groove is seen to be caused by a folding up of a ridge of the shell; there is also to be noticed some dorso-ventral flattening of the animal. Whether this groove bears any relation to any anatomical peculiarities of the animal, I have, as yet, not ascertained.

The course of longitudinal groove is represented by the dotted lines in the figure. The three other species of *Clio* represented have certain peculiarities common to all, and in a way they stand in a series. Thus in Fig. 13 are given outline drawings of two fragments of *Clio* (*Hyalocylix*) *striata*, showing an individual variation in size, *a* being a small and *b* one of the largest specimens; for although quite a large vial full of the mollusks was taken at one of the surface stations, it was very difficult to get very many of the shells, and none perfect; they, being so delicate and covering loosely only the posterior part of the animal, are easily detached and lost in collecting. The side views given in *a* and *b* of Fig. 13 show how the outline of the shell is thrown into a series of transverse grooves shown here in the profile of the figure, while the view into the anterior end of the shell gives a dorso-ventrally flattened optical section, as indicated in *c*. In Fig, 14 (*a* lateral of the posterior part only, *b* ventral, and *c* frontal view of *Clio* (*s. str.*) *balantium*) the same features are emphasized as far

as the dorso-ventral flattening is concerned, so that the sides of the shell are produced into well-defined "keels," while the dorsal (lower in the Fig. 14*c*) side of the mollusk shows the median groove, which also characterizes the dorsal lip of the shell of the Cavoliniidæ (see also the same Fig. 1*c*). The shell of the individual here figured was one of the largest of the collections. It is not uniformly grooved over its entire length, since the transverse markings tend to disappear at the most posterior part of the shell, as seen in the dorsal (left hand) face of the lateral view, *a* of Fig. 14. The exact form of the most anterior edge of the shell could not be determined on account of the breaking off of the delicate material, so that the dotted lines in *b* represent only the broken edge as it existed in the shell as preserved in the collections—not in nature. In *Clio* (*s. str.*) *pyramidata*, Fig. 15 (*a* lateral, *b* ventral, and *c* front, view) the anterior part of the shell is the most exaggerated into the lateral "keels" and the depth of the dorsal groove, as can best be seen in the optical section of the shell shown in *c;* the very wide keels are bent ventralwards and the dorsal groove (below in the drawing) appears deep and narrow in like manner. A lateral view, *a*, shows the extent of the aperture and the straightness of the posterior part of the shell and the length of the projection of the dorsal part into a grooved tongue which underlies the fins. The dotted lines in *a* and *b* show the condition of the shell when figured, but it was apparently not complete, and so may not truthfully represent the real outline of the anterior edge of a perfect shell.

Finally, in Fig. 16 are represented two views of *Cuvierina columella*, *a* from lateral and *b* from ventral view. Ordinarily, in the living specimens, one can find a good many with the embryonic shell still attached to the posterior end of the shell of the adult animal,* but they were not present in these collected by the *Albatross*, and so have the posterior end bluntly rounded, although compressed somewhat on the ventral edge, as is shown in the lateral view *a*, of which the dorsal face of the figure is toward the left. The anterior end of the shell also shows a difference in the two lips of the shell. *Cuvierina columella*, therefore, thus differs from the others; while the various species of *Clio* measure thus with each other as outlined for the figures of Pl. III.

It was purposed in entering upon the study of these collections to deal especially with the comparative anatomy of the group to be brought out by the method of serial sections, as employed in a former paper for one of the Cymbuliidæ,† but as some of the species were here represented only by empty shells, and since so many tissues of living animals were treated only with strong alcohol as they were collected, it seemed advisable to deal in this section of the work only with the distribution of the pteropods as indicated by this voyage of the vessel, to-

*See figure in Tryon's "Introduction to Systematic Conchology," Pl. 42, Fig. 9.

†On the Anatomy and Histology of Cymbuliopsis calceola. Studies from Bio. Lab., Johns Hopkins University, Vol. IV, No. 6.

gether with such relationships as may be denoted by a study of the shells themselves; and to leave for another section the completion of the study of the comparative anatomy as it may be supplemented by more material for such a study of this interesting group.

The long delay of this paper has been quite unavoidable, and I owe many thanks to Commissioner McDonald of the U. S. Fish Commission, for the generous kindness with which he has treated all matters pertaining to this and all other points of my association with him. Also the most grateful remembrances are due Dr. W. K. Brooks of the Johns Hopkins University—at whose suggestion the study of the Pteropoda and Heteropoda by serial sections was entered upon—for the countless advantages enjoyed in his laboratory at the time this subject was undertaken four years ago as one of his students.

II.—THE HETEROPODA.

These collections were taken together with the Pteropoda as discussed in the preceding part of this report, and as illustrated upon Plate 1, where the positions of the various collecting stations are indicated in the outline map.

Heteropods, accordingly, either alive or represented by their empty shells, were taken at two dredging stations as follows:

Sta.	Lat.	Long.	Depth.	Temp.	Character of bottom.	Date.
	° ′	° ′	*Feet.*	° *F.*		1887.
2751	16 34 N.	63 12 W.	687	40	Blue glob. ooze	Nov. 28
2754	11 40 N.	58 33 W.	880	38	Glob. ooze	Dec. 5

And at a series of four surface collections described as follows:

Sta.	Lat.	Long.	Temp.	Sea.	Sky.	Date.
	° ′	° ′	° *F.*			
7	8 04 N.	52 47 W.	81	Smooth	Showery	Dec. 7, 1887, 1:45 p. m.
8	3 22 S.	37 49 W.	79	Rough	Light clouds	Dec. 14, 1887, 11:30 a. m.
18	1 03 N.	80 15 W.	78	Very smooth	Overcast	Mar. 3, 1888, 8:20 p. m.
24	6 44 N.	80 27 W.	81	Light swell	Clear, starlight	Mar. 31, 1888, 7:30 p. m.

The collections contain but little material, but the individual specimens are, in nearly every instance, beautiful representatives of the various genera of this widely distributed group. Three genera are represented: *Atlanta*, *Carinaria*, and *Ianthina*.* Of these *Atlanta* is represented by about thirty large shells of the species *peronii*, found in deposit at dredging station 2751, associated with four of the delicate shells of some species of *Carinaria* (besides the Pteropoda taken there). These *Carinaria* shells also were uniformly of good size and must have belonged to large specimens of the living molluscs of the overlying

**Ianthina* is merely a specialized Gastropod, but here considered with the pelagic Heteropods for convenience.

habitat. At dredging station 2754 there was also taken one small broken *Carinaria* shell. Beyond these two collecting points east from the West India islands, no heteropod shells are recorded until station 2760 was reached (see the former section of this report, "Thecosomatous Pteropoda," p. 36), while the *Atlanta* shells dredged in the ooze at this latter point are much smaller than the specimens of the same species taken farther north at station 2751 as just described. None of the *Atlantæ* were alive. One shriveled specimen of a *Carinaria*, however, is reported from station 2751. I am unable satisfactorily to determine its origin, but from appearances conclude that it may have sunk to the bottom already dead and there have been taken with the dredge. At any rate it bears little resemblance to a specimen taken alive at the surface and is so distorted as to hide its specific distinction.

All the other material from this group of molluscs was taken alive at the surface collections as heretofore located.

I regret very much not having had opportunities of identifying all the species of these surface collections. A large specimen of *Carinaria* was taken at surface station 24, the species of which I do not know. Its body is 5.85 centimeters in length, is rather more slender than *Carinaria mediterranea*. The part of the body anterior to the prominent eyes is markedly bent ventralwards; the nucleus, situated directly opposite the foot, or fin, is long and cylindrical and stands vertically up from the surface of the body to a comparatively great height. No shell was present accompanying the specimen. The posterior part of the body extends behind the nucleus and foot about one-third the length of the animal; the eyes, also, are situated about one-third the length of the animal back from the mouth end.

The remaining material of the collections consists of Gastropods of the genus *Ianthina*, which were thus distributed at the following points: At surface station 7, two young specimens of an *Ianthina*, the species of which could not be yet determined accurately because of their immature state; at surface station 8, three specimens of an *Ianthina*, two of which are of the species *globosa*, I think, and the other undetermined; they are all rather small specimens. At surface station 18 were taken four large specimens of *Ianthina globosa* (?) and one large representative of the species *communis*; finally, at surface station 24, there was taken another specimen of the species just mentioned as undetermined.

It will be readily seen that the Ianthinidæ taken in this expedition of the *Albatross* all come from regions within a few degrees of the equator, and are not markedly distinct from each other, although separated by the South American continent. Prof. A. E. Verrill, of Yale University, did me the great kindness to go over these specimens and to compare them with the Ianthinidæ in the museum of that institution. From such a comparison, moreover, it was impossible to give the spe-

cific position to the representatives taken by the *Albatross*, since no close agreement between them could be made; and this was doubtless due to the difference in locality; for specimens in the museum at Yale were of Ianthinidæ from the region of the Sandwich Islands, in the Pacific side, and from the Arctic regions of the Atlantic side; while these from the *Albatross* collections of the equatorial regions belonged to different species which possessed intermediate qualities of different kinds, such as a different compression of the spiral, shape of aperture, etc. From the fact, therefore, that they do show distinctions from material collected at other points, the representatives of this group illustrate also the segregation and the localization of pelagic mollusca in given areas, broadly speaking. Although Ianthinidæ were so widely distributed, no empty shells were taken from bottom collecting.

BIOLOGICAL LABORATORY
WILLIAMS COLLEGE, *April*, 1893.

EXPLANATION OF PLATE LIII.

Plate I is an outline tracing of a Mercator projection map of South America, wi a part of North America, illustrating the course of the *Albatross* south from Norfo The line of dredging stations, where pteropods and heteropods were taken, be the numbers 2750–2763 according to the records of the steamer. So also the surfa collecting stations where these molluscs were taken are likewise numbered 1–31.

PLATE LIV.

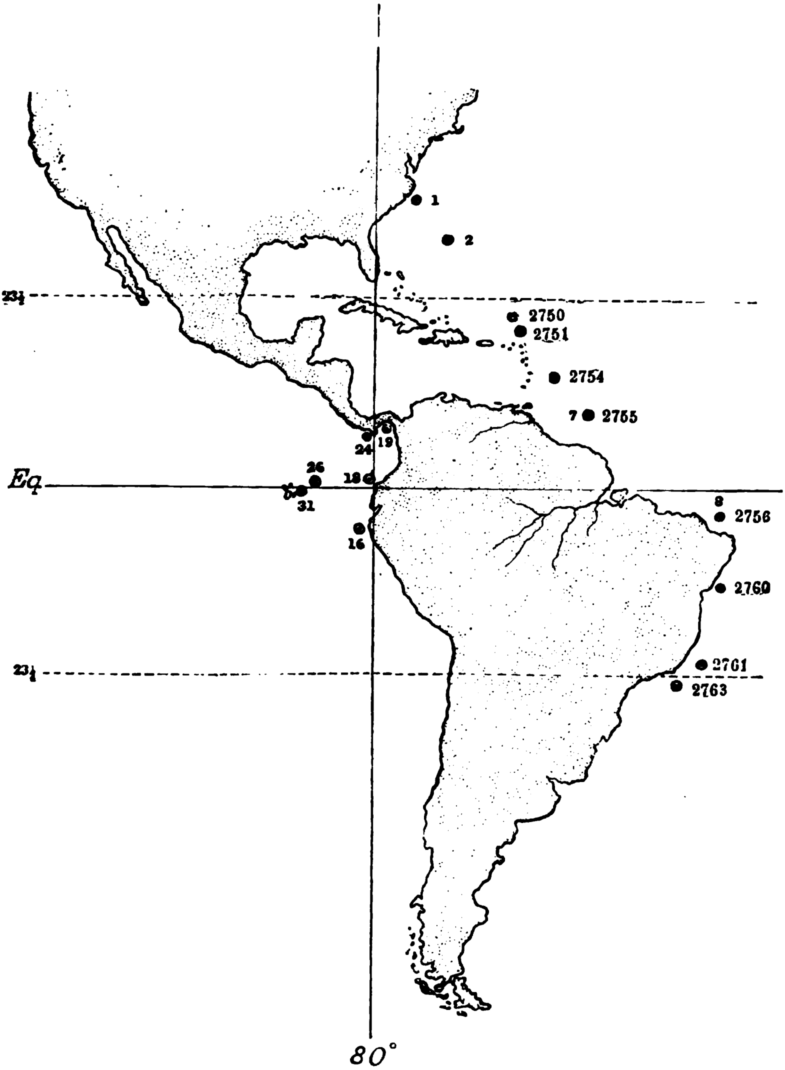
All the outlines are drawn to the same scale—five times enlarged—with an embry graph. *a* ventral, *b* lateral, *c* front view, in each case.

Fig. 1. Cavolinia *trispinosa*.
2. Cavolinia *quadridentata*.
3. Cavolinia *uncinata*.
4. Cavolinia *gibbosa*.
5. Cavolinia *tridentata*.
6. Cavolinia *longirostris*.
7. Cavolinia *inflexa*.
8. Limacina *inflata*.

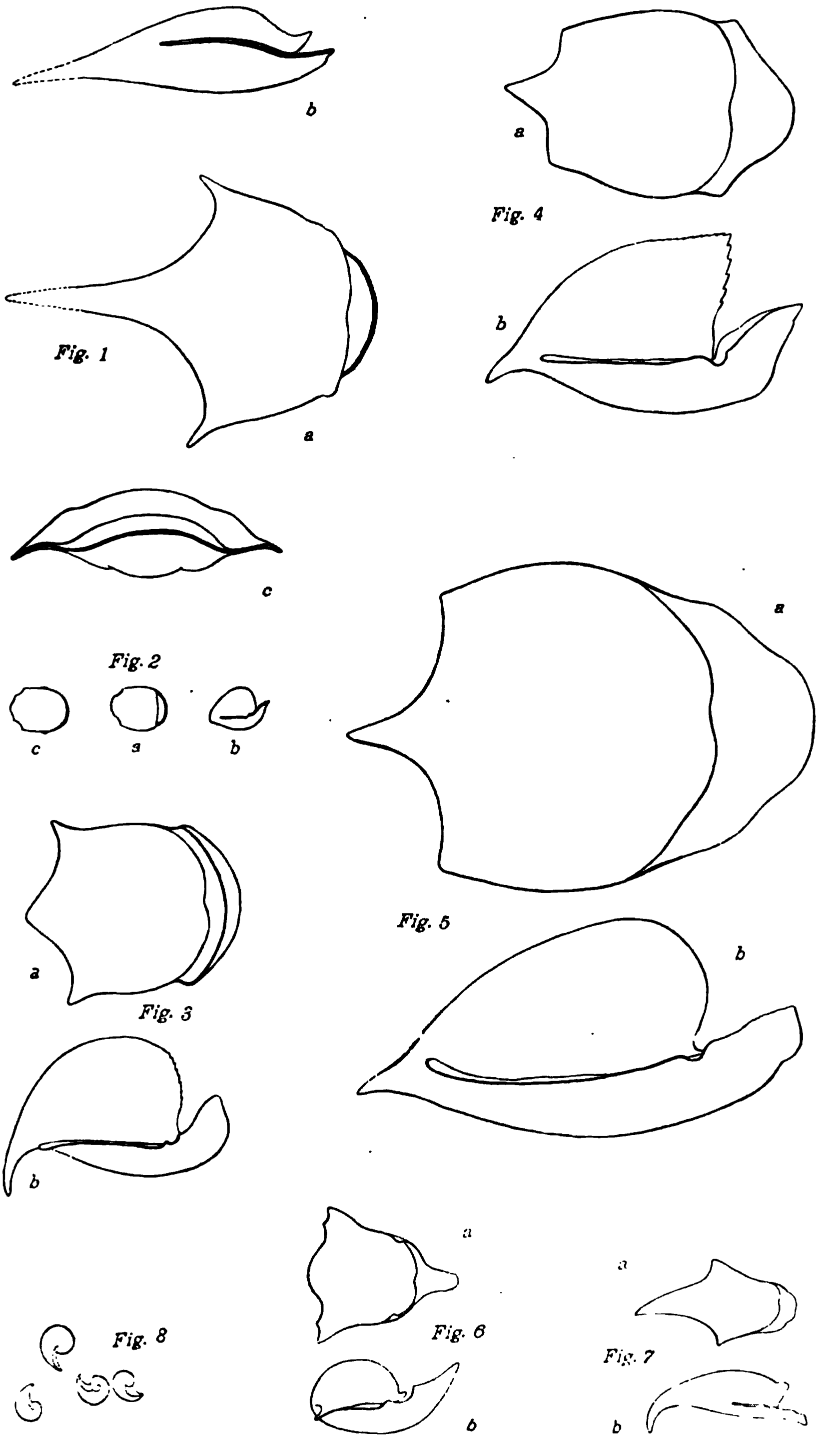
PLATE LV.

Letters as before.

Fig. 9. Clio (Creseis) *virgula*.
10. The same, variation *corniformis*.
11. Clio (Creseis) *conica*.
12. Clio (Styliola) *subulata*.
13. Clio (Hyalocylix) *striata*.
14. Clio (s. str.) *balantium*.
15. Clio (s. str.) *pyramidata*.
16. Cuvierina *columella*.



COLLECTING STATIONS OF STEAMER ALBATROSS.



PTEROPODA.

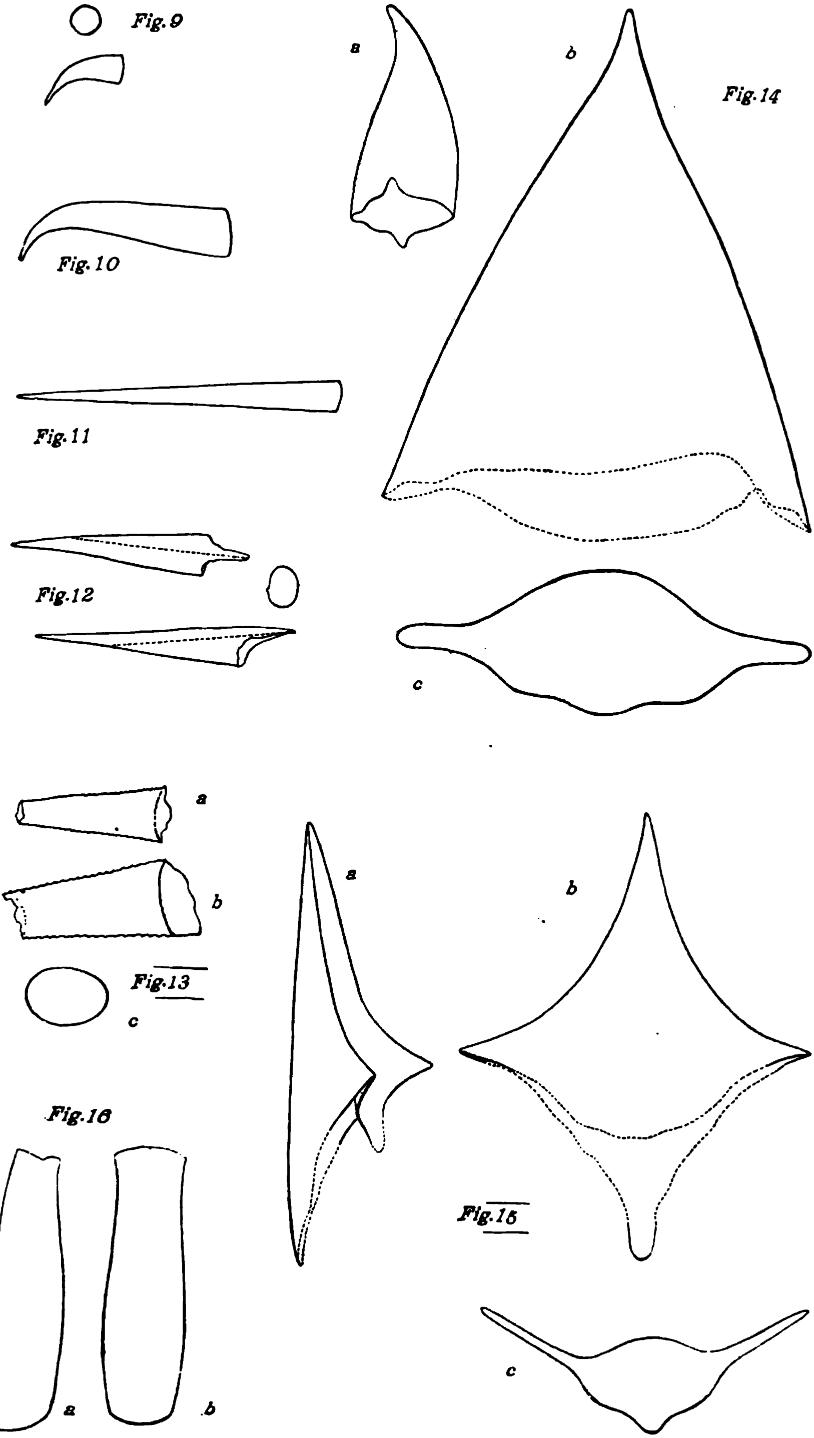


Fig. 9
a
b
Fig. 14
Fig. 10
Fig. 11
Fig. 12
c
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Fig. 13
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Fig. 16
Fig. 15
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a
b

PTEROPODA.

DIAGNOSIS OF A NEW CALIFORNIAN LIZARD.

BY

LEONHARD STEJNEGER,

Curator, Department of Reptiles and Batrachians.

Among a number of lizards collected by my friend Mr. H. W. Henshaw, at Witch Creek, San Diego County, Southern California, during the present month (May, 1893), I find a most distinct new species belonging to the genus *Xantusia*. It was taken among rocks at an altitude of about 2,700 feet. I propose to name it in honor of its discoverer.

Xantusia henshawi, sp. nov.

DIAGNOSIS.—Two interfrontonasals;* one row of superciliaries; fronto-parietals in contact; an interoccipital; pupil vertical.

HABITAT.—Witch Creek, San Diego County, California.

TYPE.—U. S. National Museum, No. 20,339; H. W. Henshaw coll.; May, 1893.

Reserving a full description, with figures, for a future paper I will here only call attention to the most salient characters by which this species may be separated from the other two species of genus. It differs from both, and in fact from all the members of the family, by the possession of a well-developed interoccipital shield. It also differs from the two Xantusias as well as from *Lepidophyma* by having two interfrontonasals, in this respect agreeing with the Cuban genus *Cricosaura*. Like *Xantusia vigilis* it has but one series of superciliaries (or supraoculars), while *X. riversiana* has two. It is longer and slenderer than the latter, and is more depressed than either. The color differs from both in being blackish-brown on the upper surface irregularly marbled with cream-colored lines which on the tail incline towards forming cross bands; under side whitish; scales on back small, uniform, flat tubercles; ventral scales in fourteen longitudinal and thirty-three transverse rows, preanal scales in three transverse rows, the two median posterior scales being the largest; about ten femoral pores on each side. Total length, 148^{mm}.; length to posterior edge of occipital plates, 13^{mm}.; length to vent, 65^{mm}.

*The nomenclature of the head shields of the *Xantusiidæ* is yet unsettled. As the most detailed description is Cope's description of *Xantusia riversiana* (Proc. Phil. Ac., 1883, pp. 30, 31) I have here adopted his nomenclature in order to avoid confusion and to facilitate comparison with the one here given.

DESCRIPTION OF A SUPPOSED NEW SPECIES OF ODONTOPHORUS FROM SOUTHERN MEXICO,

BY

ROBERT RIDGWAY,

*Curator of the Department of Birds.**

ODONTOPHORUS CONSOBRINUS, sp. nov.

SP. CHAR.—Most like *O. guttatus* Gould, but much darker and richer in general coloration, and differing positively in entire absence of any buff or tawny color in the crest.

Adult female (type, No. 44732, Mirador, Vera Cruz, Mexico, April 5; Florentin Sartorius): Pileum, including entire crest and underlying feathers of occiput, uniform brownish black, fading to sepia-brown on forehead; superciliary and supra-auricular regions lighter sepia or bister-brown; ear coverts dark chocolate-brown, approaching black along the upper margin; continued from this dark auricular patch, down sides of neck, a broad stripe, more or less interrupted, of rich chestnut, mixed with blackish; cheeks (malar and subauricular regions), chin, and throat black, each feather marked with a mesial streak of white, these markings broader and of guttate form on the subauricular region. Hind neck, sides of neck (except as described), and back rather light bister-brown, mixed with olive, indistinctly mottled or vermiculated with dusky, the feathers of the back with narrow mesial streaks of buffy whitish; inner webs of scapulars with most of exposed portion black (producing large black spots or blotches), preceded by bars of black and tawny-chestnut; outer webs coarsely mottled with olive-grayish and buffy-whitish, and marked with zigzag bars of blackish; prevailing color of wing coverts mummy-brown, varied with zigzag markings of dusky and occasional transverse spots of black, most of the feathers marked with a terminal small guttate spot of light buff; outer webs of secondaries dusky, broken by broad bars of mottled russet; tertials mixed rusty brown or bright russet and dusky, each feather with a large and conspicuous subterminal irregular lunule of black, the tip marked with a deltoid spot of deep buff; primaries dusky, their outer webs indistinctly flecked along the margin with buffy. Lower back light buffy olive-brown, indistinctly mottled with darker and with occasional small spots or flecks of black; rump similar, but rather darker, with more distinct dusky vermiculations; upper tail coverts with the same features still more pronounced. Tail

dull black, with outer webs (both webs of middle feathers) varied with narrow broken or zigzag bars of rusty brown. Under parts grading from rich, warm brown* on the chest to bright chestnut on flanks, each feather ornamented by a mesial guttate streak or spot of white, margined with black; anal and femoral regions light brownish, indistinctly barred with grayish dusky and olive-tawny; under tail coverts black, irregularly spotted, and barred with light olive-tawny. Bill black; "iris brown;" feet horn-color. Length (skin), about 10.00; wing, 5.60; tail, 2.90; exposed culmen, 0.73; depth of bill at base, 0.50; tarsus, 1.62; middle toe, 1.35.

An adult female from Protrero, Cordová (No. 41649, December 20, 1869, F. Sumichrast), is essentially like the one described, but presents the following slight differences: The top of the head is not nearly so dark, scarcely approaching black even on the longer feathers of the crest, while, except these latter, the feathers have distinct but narrow light brown shaft-streaks; the white streaks on cheeks and throat are broader; the under parts are somewhat less richly colored, with the white markings broader and less regular, while the rump and lower back are more distinctly vermiculated and freckled with dusky. Wing, 5.50; tail, 2.65; exposed culmen, 0.75; depth of bill at base, 0.50; tarsus, 1.62; middle toe, 1.50.

The seven specimens of *O. guttatus* Gould with which these two Mexican birds have been compared are all from Costa Rica, and all have the bright ochraceous crest (overlaid by dusky), as shown in Gould's plate. The birds described and figured by Gould are said to have come from Honduras. The male represented by him shows the conspicuous ochraceous crest and agrees otherwise with the Costa Rica bird; but the other figure, representing what Gould says is the female, is without any ochraceous, though not otherwise different; and he describes the female as different from the male "in having the crest of a uniform brown, and in the black of the throat being less extensive." I am not, however, inclined to credit the alleged sexual character of this difference in the color of the crest, since two of the seven Costa Rican specimens (one of them, moreover, an immature bird) are marked as females by the collectors and have the crest colored exactly as in the males.

*Intermediate between mummy-brown and Prout's brown.

A SUBTROPICAL MIOCENE FAUNA IN ARCTIC SIBERIA.

BY

WILLIAM HEALEY DALL,

Curator of the Department of Mollusks.

(With Plate LVI.)

In the northeastern angle of the Okhotsk Sea, between the parallels of 58° and 62° north latitude and in about 158° east of Greenwich, lies a large body of water known as the Gulf of Penjinsk. It extends in a northeast and southwest direction for about 300 miles and has a greatest width of some 140 miles. At its head it is divided by a large peninsula into two narrower arms, of which the westernmost is called the Gijigá Bay and the other Penjinsk or Zhinsk Bay.* At the head of the former a small river comes in, some distance up which is the small Russian trading post of Gijigá, which, to the best of my knowledge at present, is the only permanent settlement anywhere about the gulf.

This arm of the Okhotsk Sea has not been visited, so far as recorded, by any scientific explorer, unless we except the officers of a small coast-guard steamer maintained by the Russian Government in the Okhotsk Sea, and who did some hydrography in this vicinity. No collections from this region are mentioned in any work on the natural history of this region which is accessible to me.

From Russian travelers and the explorers of the Telegraph expedition of 1865–'67, as well as the whaling captains of the North Pacific fleet, something is known of the characteristics of the gulf. It is ice-bound for more than half the year. Late in May simultaneously with the freshets in the rivers falling into the gulf, the ice near its head and along its shores becomes loosened and a certain amount of open water will be formed between the main floes of the Okhotsk Sea and the land about the gulf. A large number of whales, supposed to be a variety of the true Arctic Bowhead or *Balæna mysticetus*, were formerly in the habit of resorting to these sheltered bits of open water where they brought forth their young. This came to the knowledge of the whalers, and about 1849 the whale fishery was established in the Okhotsk Sea and maintained there until the whales became too scarce to warrant their pursuit. Since the ice prevented the access of the whale ships, they were accustomed to send boat parties through the

* The nomenclature in these parts is somewhat unsettled and charts differ, but the names here used are derived from the Russian Hydrographic Office chart.

[Proceedings National Museum, Vol. XVI—No. 946.]

narrow strip of open water along the shores until the open water at the head of the bays was reached, according to Scammon, usually about the 20th of June. With the boats whaling was carried on from camps on shore until, in July or later, the main floes had so broken up as to allow the ships to penetrate the bays.

The shores around the gulf are, in many places, cliffy or precipitous and the beaches stony, though the depth of water is moderate, nowhere exceeding 100 fathoms, as far as known. While the latitude of Penjinsk Gulf is that of Shetland or the South Cape of Greenland, and it is not within the Arctic Circle, yet its climate and conditions are essentially arctic, and it is the only region where the true arctic whale has ever been known to breed except in the Polar Sea. The marine fauna probably resembles that of other parts of the Okhotsk Sea where it is known to be extremely scanty along the shores, profuse in individuals in water deep enough to be free from grounding ice, and strictly arctic everywhere. Further south, off the west shore of the peninsula of Kamchatka, is a noted codfishing ground, but no record of any attempt to fish in the gulf has been brought to my notice. In the summer a fairly large run of salmon of several species occurs in most of the rivers falling into the gulf and wild fowl are abundant spring and fall as they come and go from their breeding grounds at the mouths of the rivers farther north.

On the shore of one of the small bays which put out from the gulf coal has long been known to exist, though the exact locality is not indicated on any of the charts I have been able to examine. The place was known to the whalers as Coalmine or Coal Bay. In 1866 the Russian transport *Sakhalin*, which had brought supplies for the telegraph explorers, being short of coal, obtained a quantity from this place, which enabled her to reach the Amoor River, though the quality of the fuel was poor. It seems to resemble the Eocene lignites of Alaska rather than the coals of greater age and density.

From this locality in 1855, when a member of the Ringgold and Rodgers exploring expedition in the North Pacific, the late Dr. William Stimpson obtained a small collection of fossils, comprising six species of mollusks, which were deposited by him on his return to America in the Museum of the Smithsonian Institution, where they have since remained.*

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* Although no extended data accompany the specimens, I learn through the courtesy of Lieut. Commander Richardson Clover, U. S. Navy, hydrographer of the Navy Department, that the U. S. S. *Hancock*, Lieut. H. K. Stevens, U. S. Navy, commanding, visited Coal Bay early in August, 1855, and it was doubtless by some one on board that the species were collected. The position assigned to Coal Bay on the map of the expedition is in latitude 60° 17′ north and longitude 161° 55′ east of Greenwich. It is noted that coal was found abundantly, but of inferior quality for generating steam. Some account of the *Hancock's* visit to Coal Bay is given by A. W. Habersham in his volume entitled "My Last Cruise" (etc.). Philadelphia, Lippincott, 1857, pp. 329–371.

The aspect of these shells indicates for them a Miocene age, to which they were assigned by the late paleontologist F. B. Meek. The matrix is a light-brown or grayish, fine grained, rather hard sandstone, exactly like many of the Miocene sandstones of the adjacent Alaskan coast. Taking the occurrence of the beds of lignite into consideration we may suppose that they are, like the Alaskan lignites of the opposite shore of Bering Sea, immediately succeeded by a bed of marine Miocene, from which these fossils may have been derived. In cleaning off some adherent matter it was found that a few small particles of a stony alga still adhered to the fossils and retained some of its original green color. This shows that the alga is not a fossil, and indicates that the specimens were obtained upon the beach, where they may have remained some time after being weathered out of the original matrix. One specimen, a large oyster, is somewhat worn, as if by the waves, and still retains in its shell substance something of the purple color which characterized the shell while living.

DESCRIPTION OF THE SPECIES.

Ostrea gigas Thunberg.

Ostrea gigas Thunberg, Kong. Vet. Ak. Handl. t. XIV, for 1793, p. 140, pl. 6, figs. 1–3; Lischke, Jap. Meeresconch, I, p. 174, 1869; II, p. 160, pl. 14, figs. 1, 2, 1871; III, p. 114, 1874; Dunker, Ind. Moll. Jap. p. 249, 1882.

Ostrea Laperousii Schrenck, Bull. Imp. Acad. Sci. St. Peterb, IV, p. 411, 1861; Reisen in Amurl., Moll., p. 475, pl. 19, figs. 1–6, 1867.

Ostrea talienwhanensis Crosse, Journ. de Conchyl., X, p. 149, pl. 6, fig. 6, 1862.

Ostrea talienwahnensis Sby., Conch. Icon. Ostrea, pl. 10, fig. 21, 1871.

? *Ostrea borealis* Jay, Perry's Japan Exp. p. 296.

Coalmine Bay, Gulf of Penjinsk, Okhotsk Sea, W. Stimpson, Mus. Reg. No. 4787.

The fossil comprises the whole of the upper and most of the lower valve, held together by the indurated matrix and measuring about 103 millimetres long by 90 millimetres in greatest width. The specimen is somewhat waterworn, evidently after weathering out of the matrix, but retains partly the purplish color common to this species. It appears to agree in all essentials with the recent shell.

This oyster has, like the *O. virginica* of America (which it much resembles), a very wide range in latitude, extending from the China seas to the west coast of the island of Sakhalin and in Japan to Nagasaki. But the fossil, so far as its condition permits us to judge, represents the southern form of the species rather than that which it assumes near the northern extreme of its present range.

Semele Stimpsoni n. s.

Pl. LVI, fig. 5.

Shell sub-orbicular, moderately compressed, sculptured with numerous wide, low, rather irregular concentric ridges which are angulated

at the summit and sometimes broken up or confluent on the posterior part of the shell; also by fine radiating striæ, strongest near the beaks, crossed by obvious incremental lines and nearly or quite obsolete toward the base, in the adult; the posterior fourth of the shell is marked off from the rest by an obscure radial depression which gives the hinder end the appearance of being slightly compressed and twisted to the left; cardinal region behind the beaks marked by an obscure narrow lanceolate impressed area or escutcheon; hinge with (in the left valve) a large cartilage pit, in front of which is a narrow, thin cardinal tooth with an anterior lateral very short and closely adjacent, the posterior lateral also extending but little behind the end of the cartilage pit; interior surface smooth, the pallial line distinct, the sinus broad, bluntly rounded in front and extending to a vertical line dropped from the beak. Lon. of left valve, 33; alt., 30; semidiameter of shell, 7 millimetres.

Two left valves (Mus. Reg. No. 4788) were obtained from the bed at Penjinsk Gulf by Dr. Stimpson, in whose honor the species is named.

This species most closely resembles *S. modesta* A. Adams* from West Africa and St. Helena, a species which is somewhat higher, more inflated, with longer lateral teeth, a smaller cartilage pit, and more rounded concentric sculpture. In both the sculpture near the beak tends to be more nearly lamellar and the radiating grooving more prominent.

The nearest relative geographically which *S. Stimpsoni* possesses is the similarly sculptured form, referred to by Schrenk under the name of *S. californica*, which is found in the Japan Sea and the Strait of Tartary. While many Japanese shells are common to Northwest America, it can hardly be said that the identity of this species, which I know only by Schrenk's figure, with the Gulf of California shell is fully established. It is possible that our fossil may prove identical with the living form recorded by Schrenk, but this can only be determined by a comparison of specimens.

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*This was referred by Mr. E. A. Smith, of the British Museum, to *S. cordiformis* "Chemnitz," which is the West Indian and East American species variously known as *S. reticulata* (Gmel.) Wood, *orbiculata* and *radiata* Say, *subtruncata* Sby., *Jayanum* C. B. Adams, and *pulchella* A. Adams. From these, however, the St. Helena shell is quite distinct, as shown by a series kindly presented to the National Museum by Capt. Turton. Its sculpture is never sharp and rasping to the touch as in the West Indian shell, and all the specimens (five) show a minute lunule, under which the shell substance is of a deep claret-brown color, forming a very conspicuous spot of color and not occurring in any of the American shells from over fifty different localities. The concentric ridges are broad and blunt in the *S. modesta*, while they are represented in the American species only by thin sharp lamellæ. As Chemnitz was a binomial writer only accidentally, and did not adopt the Linnean system of nomenclature, his name can not be accepted even for the American shell, which will best be known by the name of Gmelin, adopted and illustrated by Wood, in the belief that the shell is the *Tellina reticulata* of Linné, a conclusion to which the researches of Hanley on the Linnean types lend a reasonable probability.

Siphonaria penjinæ n. s.

Pl. LVI, fig. 2.

Shell irregularly ovate, depressed, alternately radiately sculptured with riblets and threads; apex eroded in the specimens, but situated at about the posterior third; lines of growth obvious; margin entire or slightly crenulated by the sculpture; interior smooth, muscular impressions strong, interrupted at the right as usual in the genus; the shells showing evident color markings consisting of alternate light and dark radiating lines much as in *S. lineolata* Orbigny. Lon. of shell, 20; max. lat., 15; alt. (somewhat eroded), 4 millimeters.

Two specimens (Mus. Reg. No. 4791) received from Dr. Stimpson.

This species recalls *S. lecanium* Cpr., of the northwest coast of America, but is very closely related to the *S. radiata* Ad. & Rve. figured from the China seas in the "Voyage of the *Samarang*." Two species of *Siphonaria*, *S. fuliginata* Rve. and *S. atra* Quoy & Gaim., are known from the present seas of Japan and Korea, but neither so closely resembles our fossil as the more tropical species above mentioned, which indeed is hardly distinguishable from the form we have described.

Conus okhotensis n. s.

Pl. LVI, fig. 4.

Shell short, stout, solid, of about eight whorls; spire low and rounded, suture appressed, with a few obscure spiral striæ in front of it; shoulder of the shell rounded; sides smooth, hardly striated even over the canal, aperture rather wide, outer lip straight, sutural sinus shallow; pillar simple, slightly twisted at the end; lon. of shell, 50; lat., 35 millimeters.

A young and an adult specimen (Mus. Reg. No. 4789) were presented by Dr. Stimpson.

This species is not unlike *Conus californicus* on a larger scale, and belongs, as well as can be judged in the absence of color markings, to a group (*Chelyconus*) which is most abundantly represented in the Moluccas and on the shores of Africa. There does not appear to be at present any closely related species on the Japanese coasts, but *C. fulmen* and *C. pauperculus* are found in that region and would in a general way be associated with it. Among the recent species in the National Museum, *C. glaucus* from the Moluccas presents the closest parallel in form and conchological characters.

In the larger of the two fossil specimens a faint indication of what might be taken as traces of spirally disposed color marks is perceptible, but these are not sufficiently distinct to permit of a dogmatic assertion that they are traces of color and not an incident of mineralization.

Cerithium cymatophorum n. s.

Pl. LVI, fig. 1.

Shell stout, solid, short, of seven or more whorls; nucleus lost; aperture defective; sculpture characterized by a constriction about the

middle of the whorl, above which there is only spiral sculpture; in front of it the whorl is marked with about eight prominent rounded waves or obscure ribs, with wider interspaces, which become obsolete on the last half of the last whorl; spiral sculpture of fine, sharp, minutely channelled incised lines with much wider, smooth, flat-topped interspaces; suture appressed; base constricted about the middle, sculptured with more crowded incised lines; pillar with a moderate callus; lon. of shell, 35; max. diam., 17 millimeters.

One specimen (Mus. Reg. 4790) presented by Dr. Stimpson.

This species is related to the group represented by *C. vulgatum* Brug., *C. guinaicum* Phil., and *C. æmulum* Phil., the second of which extends its range from the Gaboon, West Africa, to the Philippines, Lord Hood's Island, and Japan, if authorities may be trusted. The fossil is, however, sufficiently distinguished from any of them by its form and sculpture. The group at present is only represented in warm-temperate, or subtropical waters. The specimen described had been attacked by *Cliona* before fossilization and more or less perforated, beside sustaining the loss of its outer lip. A much smaller, but in many respects similar, species is found in the Older Miocene of Florida.

Diloma (Chlorodiloma) ruderata n. s

Plate LVI, fig. 3.

Shell small, turbiniform, rude, with little nacre, of about four whorls; whorls rounded, suture appressed and slightly constricted, sculpture only of rather rude lines of growth; surface composed of a dark shell layer, with obscure indications of spiral lines of lighter color; base full, slightly flattened, a narrow impressed area around the umbilicus, which is barely perforate and nearly covered by a small callus; aperture rounded; pillar short, concave, ending in a small, low, narrow, tooth-like prominence; throat smooth. Alt. of shell 15; max. diam. of base, 13; min. diam., 11.50 millimeters.

Two specimens (Mus. Reg. No. 4797) were received. No species very closely related to this shell is at present known from the Japanese fauna, but there are a number of them in the Australasian seas. The genus is perhaps represented by *D. perplexa* Pilsbry, of Japan. I have referred the fossil to *Diloma* rather than *Gibbula*, chiefly on account of the sculpture and scant pearly layer, but on such occasions it is impracticable to determine positively the precise relations.

GENERAL CONCLUSIONS.

The evidence afforded by these fossils indicates unmistakably that the fauna including them must have flourished in waters at least as warm as those which at present occupy the Japan Sea, at a distance of more than a thousand miles to the southward. The oyster and *Siphonaria* show that the fauna was litoral and not an offshore or deep-

water assembly. Faunally the species point to a distinct analogy with those of the China and South Japan seas, and, like the existing fauna of those seas, they indicate bonds of relationship with the west coast of Africa and the coast of Australia rather than with the Indo-Pacific fauna of northeast Africa and the Malay Archipelago. These curious analogies have been noted by all those who have studied the mollusk fauna of Japan, and their explanation is one of the trophies for which future students, with fuller geological knowledge of oriental countries, may compete. At present hypothesis could rest only on speculation.

It is not often that so small a number of specimens as those we have described would contain the elements necessary for deciding on so many points of interest, but the present case is a fortunate exception.

We may now consider the climatic relations indicated by this little collection. There are no observations on record from the Gulf of Penjinsk, but the climate can differ but little from that of Okhotsk, which is situated in the same latitude as that of the mouth of the Gulf of Penjina and some 350 miles to the westward. If there is any difference it is that the gulf is colder than Okhotsk, since Scammon indicates that open water occurs about June 20 in the gulf, while the average at Okhotsk is about two weeks earlier.

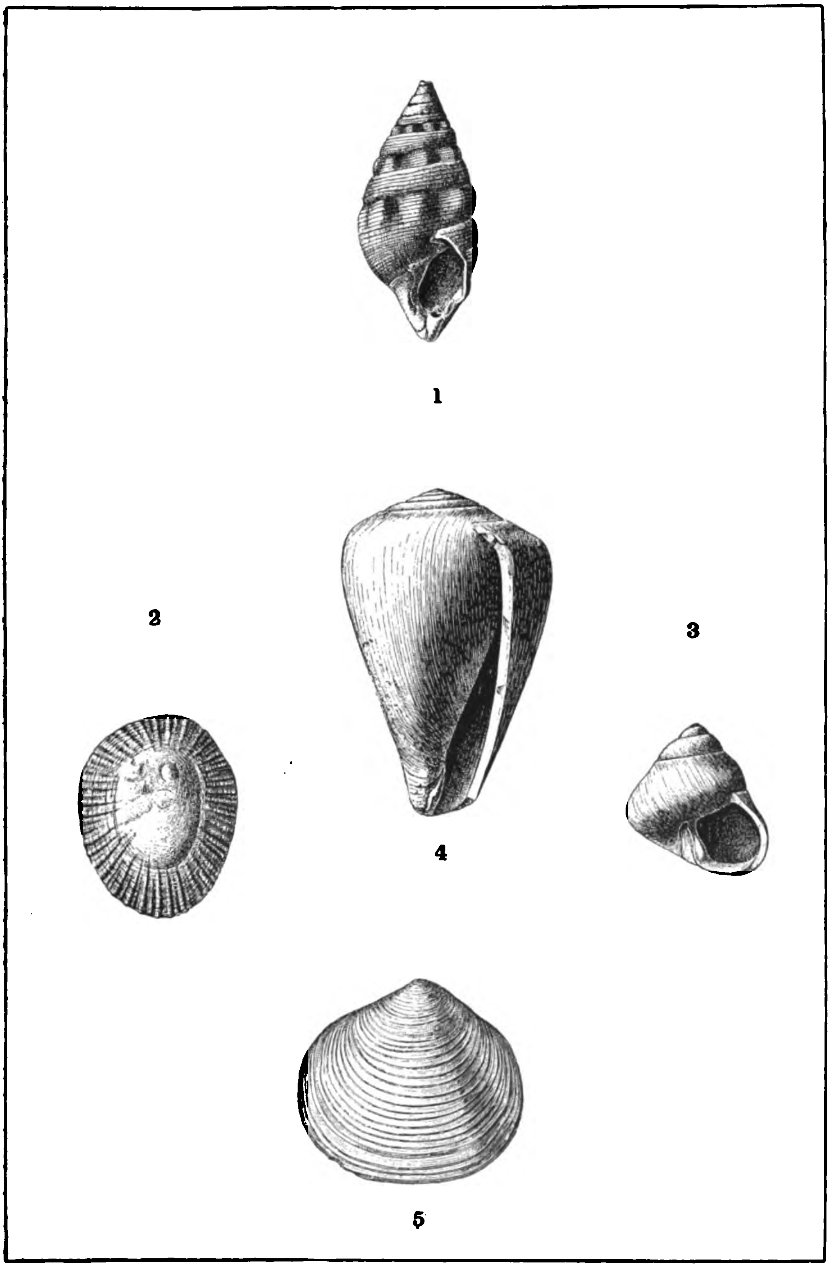
We find Okhotsk has a mean annual temperature of the air of 23.1°, spring having a mean of 23.9°, summer of 52.1°, autumn of 24.6°, and winter of minus 8.2°. The temperature of the sea water does not rise above 40° F. (except in the harbor) during the warmest part of the summer, and for two-thirds of the year it is at or below the freezing point. It may therefore be assumed that the water climate of Penjinsk Gulf does not essentially differ from that which is offered by those parts of the Polar Sea which are free from ice during the summer months. The climate of the region indicated as a natural climatic home by such an assemblage of fossils as those we have been discussing, should have a summer sea-water average temperature of 70°, and a winter average of 60° F. at least, with a minimum temperature never approaching the freezing point. As the difference between the temperature of the air and that of the water can not permanently remain much greater than 5° or 6°, it follows that the annual mean temperature of the Gulf of Penjinsk in Miocene time (or the era indicated by our fossils) can not have been much less than 60° F., and was probably higher. That is to say, since this fossil fauna flourished in these waters the annual mean temperature has diminished by 30° to 40° F., at the most moderate calculation.

It is perhaps very late in the day to refer to the hypothesis which explained the warm water Old Miocene of the north Atlantic shores by assuming a shifting of the polar axis so that the pole at that time would have been situated somewhere in central Siberia. That hypothesis has few if any friends at the present time. But it may not be amiss to point out that, if it were necessary to put a quietus on that moribund specu-

lation, the presence of a warm water Old Miocene in eastern Siberia, such as our present fossils indicate, would be quite sufficient to prove that no polar conditions in the modern sense could have existed there during that epoch of geological time.

PLATE LVI.

Fig. 1. *Cerithium cymatophorum* Dall, lon. of original 35 millimeters. Page 475.
2. *Siphonaria penjinæ* Dall, lon. of shell 20 millimeters. Page 475.
3. *Diloma* (*Chlorodiloma*) *ruderata* Dall, alt. of shell 15 millimeters. Page 476.
4. *Conus okhotensis* Dall, alt. of shell 50 millimeters. Page 475.
5. *Semele Stimpsoni* Dall, left valve, lon. of original 33 millimeters. Page 473.



SIBERIAN TROPICAL MIOCENE FOSSILS.

NOTES ON A COLLECTION OF BIRDS FROM EASTERN NICARAGUA AND THE RIO FRIO, COSTA RICA, WITH A DESCRIPTION OF A SUPPOSED NEW TROGON.

BY

CHARLES W. RICHMOND.

The accompanying list, in which are embodied the notes made during a year's residence in eastern Nicaragua, is based on collections and observations extending from February 1, 1892, to January 19, 1893. Specimens of most of the species were obtained, and of others, nearly all North American, only those well known to me have been admitted unless otherwise stated.

Greytown, or San Juan del Norte, is situated on a small lagoon at the mouth of the San Juan River, on the Caribbean coast of Nicaragua. It is almost surrounded by marshes and silico* swamps, yet the climate is as healthful as at any other point on the coast. This is due, probably, to the sandy nature of the soil on which the town is built, and to the influence of the sea air. The climate of the region is apparently not as deadly as many suppose. Many foreigners live in the country for years, retain their health, and are seldom or never troubled with "the fever." Unless one is peculiarly susceptible to malarial influences no bad effects are liable to attend a sojourn in the country if proper care is taken to preserve the health, but one is very liable to be led into various exposures on first reaching the country, especially if one has left a severe winter behind in the north. The country a few miles inland is not as salubrious as directly on the coast, and those who contract the fever there frequently recover entirely after a trip to the seashore.

The coast country has a protracted rainy season of eight or nine months, from May to January, with occasional spells of fair weather during the other three or four months. Some years the "dry" season is said to fail altogether. The rainfall is enormous, and from a report of observations by officers of the Nicaragua Canal Company it appears that over 296 inches fell at Greytown during the year 1890. The precipitation during July of that year was nearly 2 inches per day. The

*The local name of a species of palm which constitutes the prevalent growth in most swamps of the coast district.

temperature is even and seldom reaches the nineties or goes below 70° F.; the average is about 85° at noon and 72° at night.

Two weeks were spent at Greytown, where collecting was confined to the bushy thickets and clumps of bushes on the outskirts of the town, and to fruit trees in the gardens. The species collected were mostly those found in all clearings and open places along the coast. My brother, W. L. Richmond, and Mr. G. E. Mitchell, collected for a few days at a cacao plantation on the San Juan near Greytown, and secured several species not noticed elsewhere. Four days, February 23–26, inclusive, were spent at San Carlos, at the southeast end of Lake Nicaragua. The collecting ground there was much the same as that at Greytown, clumps of bushes, thickets of small extent, and a sprinkling of large trees on the lowland along the lake shore. The dry season at San Carlos had an actual existence, and the climate was delightful. The next fourteen days, February 27 to March 11, were occupied on the Rio Frio, which flows into the San Juan opposite San Carlos. The river was ascended to the Guatusa Indian settlements, at the head of canoe navigation in the dry season, and a few days spent in their neighborhood. With the exception of two clearings the river banks were uninhabited. Owing to this solitude animal life was abundant. Water birds were extremely numerous. Monkeys of three species were seen day after day in large troops. Alligators, turtles, and lizards actually swarmed, and sharks, probably the same as found in the lake, were found as far as the Indian habitations. Dense forests extend along the Frio for miles, with occasional stretches of savannah land. Narrow patches of tall grass line the banks in low places, where the heavy timber is replaced by jungles of smaller trees. The altitude of the river, as far as covered by me, is less than 150 feet, and the vegetation therefore strictly tropical.

The time from March 12 to April 17 was passed on the San Juan and at Greytown, but no collecting was done, and much of the spring migration of North American birds was missed. I have endeavored to give dates in connection with the North American species, which may be of some value in the study of the migration of those birds, but it will be remembered that the notes cover parts of two migrations, and that a species noted from October to February was seen first in February and again on its return from the north in October; also that species common at Greytown and noted as last seen in February (when my observations ended there) may really have remained a month or more later. The terms winter, summer, etc., have been used to designate the same seasons as in the north.

The time from May 1, 1892, to January 19, 1893, was passed on the Escondido River, principally at the "I. P." plantation. As by far the most of my time was spent on that river, and most of the species observed elsewhere were also collected there, I have included in the list

two or three species not met with by me, but collected by Mr. Henry Wickham* a number of years ago.

The Escondido, formerly known as Blewfields or Bluefields River, is probably the most important one on the coast of Central America, with the exception of the San Juan. There is no troublesome bar at the mouth, as is usually the case, and large ocean steamers ascend the river to Rama, 65 miles from the mouth. Two rivers, the Rama and Sequia, join at the town of Rama and form the Escondido. The banks for many miles, including both branches above Rama, are lined with banana plantations, the monotony of which is broken by the numerous picturesque ceiba and ebo trees which have been left standing in the clearings, and the dense tropical forest in the background. In the last 15 or 20 miles of its course the river winds through dreary silico swamps and empties into Bluefields Lagoon, a sheet of water 15 miles long and 7 miles broad. These swamps are of little interest; they are covered with a dense growth of silico palms and trumpet trees, and bird life is scarce.

The International Planting Company's plantation, or "I. P.," as it is familiarly called, is 50 miles from Bluefields. A creek joins the river at this plantation, and affords an excellent means of reaching the heavy forest in the rear. Many of the forest birds delight to frequent the open space where the creek runs through the woods, and a canoe trip in the early morning under these circumstances usually enables one to get a fair lot of birds. Shortly after reaching the "I. P." plantation work was much interfered with by an attack of the fever, due entirely to carelessness, which eventually led to my return to the United States.

Special attention was given to the colors of soft and fading parts of specimens collected, and in all cases where a definite color of such parts is given the part was compared with Ridgway's Nomenclature of Colors.

My thanks are due Mr. Ridgway, curator of the department of birds, U. S. National Museum, who has allowed me the use of various specimens in the Museum series for comparison with my own, and has aided me in other ways; and to Messrs. G. E. Mitchell and W. L. Richmond for records from Greytown and on the Escondido. I can never sufficiently thank Mr. Sam. A. Risley, of the International Planting Company, who rendered me so many favors during my stay there that it would be useless to try to enumerate them. He contributed in many ways to the success of my work. I met with so many offers of assistance and expressions of good will from Americans and others with whom I came in contact in Nicaragua that with one exception my thanks are due them all.

*List of birds collected on the Bluefields River, Mosquito coast, by Mr. Henry Wickham, by P. L. Sclater, F. R. S., and Osbert Salvin, M. A., F. Z. S. Proc. Zoöl. Soc. Lond., 1867, 278-280.

Family TURDIDÆ.

1. **Turdus mustelinus** Gmel.

Heard several times on the Escondido; first noted November 7.

2. **Turdus ustulatus swainsonii** (Cab.).

One shot October 3. A large flight occurred on the 14th.

3. **Merula grayi** (Bonap.).

Common on the Escondido and also observed at Greytown. Its song is not unlike that of the American Robin (*Merula migratoria*), although somewhat inferior. On the Escondido the banana plantations are its favorite haunts, and it frequently places its nest in the bunches of fruit, occasionally building in the space at the junction of a leaf with the stem of the plant. A nest secured July 1 resembled that of *M. migratoria* in having the walls well plastered with mud. It contained two fresh eggs, measuring 1.09 by 0.78, and 1.14 by 0.79; pale bluish-gray, spotted and blotched with reddish-brown.

Two young birds just able to fly were found June 18.

It is interesting to note that in the tropics many species lay but two eggs. The domestic fowls are not as prolific as in the north apparently, and their eggs are small-sized.

Family SYLVIIDÆ.

4. **Polioptila bilineata** (Bonap.).

Not very common on the Escondido and at Greytown.

Family MIMIDÆ.

5. **Galeoscoptes carolinensis** (Linn.).

Rather common; observed from October 28 to April 17.

Family TROGLODYTIDÆ.

6. **Henicorhina prostheleuca** (Scl.).

Apparently not common. The bird skulks close to the ground in the thick underbrush of the forest and is quite shy.

7. **Thryophilus costaricensis** Sharpe.

Common at Greytown and on the Escondido, also observed on the Rio Frio. It is most abundant during the winter months and possibly may not occur during the breeding season; at any rate, it escaped my notice during the early summer, and it was not until July that the birds became conspicuous through their loud but rather monotonous song. They are mostly confined to thickets bordering streams, and

keep so well concealed that it is difficult to secure specimens. At times they appear in plain sight and do not manifest any unusual shyness.

8. **Thryophilus thoracicus** (Salv.).

Rather common. This species is found in the forest, in trees, usually at a distance of 10 or 20 feet from the ground. It spends its time much as does *Thryothorus atrogularis*, searching among the bunches of dead leaves and masses of dead material lodged in vines. It occasionally scolds in a somewhat harsh voice, but on the whole is rather a silent bird.

9. **Thryophilus zeledoni** Lawr.

One specimen secured February 13 in a thicket at Greytown. In its actions it resembled the following:

10. **Thryothorus atrogularis** Salv.

Common; appears to be absent part of the year. First seen September 7, and afterwards common until the end of February. Found in the forest, 10 or 20 feet up in the trees, searching for food in the thick tangled masses of vines, or scratching in the accumulations of vegetable matter lodged in palms. It is not very noisy, seldom uttering its rather harsh note.

11. **Troglodytes intermedius** Cab.

Common on the Escondido. A pair or more are found on every plantation. The birds are very familiar, hopping around through the houses and outbuildings like the House Wren (*T. aëdon*), and the song is almost exactly the same, but rather less musical. Nesting apparently occupies a considerable portion of the year. I found young in July and August, and nest building was observed in November and January. The nests were constructed of fresh grass, with a small entrance in the side. One was located in a fork in the top of a small guava tree, and another was built in a bunch of grass which had grown through an opening in an outbuilding.

Family MNIOTILTIDÆ.

12. **Protonotaria citrea** (Bodd.).

Quite common through the winter months; first seen September 2.

13. **Helminthophila pinus** (Linn.).

Apparently rare; shot one at Greytown February 8 and saw another on the Escondido January 17.

14. **Helminthophila chrysoptera** (Linn.).

Uncommon during the winter; specimens obtained November 5.

15. **Helminthophila peregrina** (Wils.).

Shot a specimen on the Escondido October 24; two days later the species had become abundant, hundreds passing by in an almost continuous stream, pausing an instant in the trees in front of the house, then off again, following the course of the river westward. This migration continued until the 29th, after which date no more were observed.

16. **Compsothlypis americana** (Linn.).

One specimen, in company with some Tennessee Warblers, shot October 26 on the Escondido.

17. **Dendroica æstiva** (Gmel.).

Abundant winter resident. First seen August 9, and afterwards abundant, swarming in the tall grass bordering the Escondido River. Remains until late in February at least.

I never heard this or any of the other North American birds sing here.

18. **Dendroica coronata** (Linn.).

Not very common. Observed at Greytown and on the Escondido. Several noticed November 28, and one on February 16.

19. **Dendroica maculosa** (Gmel.).

Quite common in winter. First seen October 27, and last on February 5.

20. **Dendroica pensylvanica** (Linn.).

Abundant during the winter months, noticed from September 29 to February 16.

21. **Dendroica dominica albilora** Baird.

One specimen collected at Greytown, February 12.

22. **Seiurus aurocapillus** (Linn.).

Rather rare, first seen November 7, and occasionally noted until May 6.

23. **Seiurus noveboracensis notabilis** (Grinn.).

Abundant in winter, from September 20 until May 5.

24. **Seiurus motacilla** (Vieill.).

Rather rare, first seen October 23.

25. **Geothlypis formosa** (Wils.).

Very common, first seen September 22.

26. **Geothlypis philadelphia** (Wils.).

Shot an immature male on February 4, at Greytown; the only one seen.

27. Geothlypis trichas (Linn.).

Common, first observed October 28.

28. Geothlypis bairdi Nutting.

Common on the Rio Frio in Costa Rica. One specimen taken at Greytown and one at Colorado Junction, on the San Juan. Rare on the Escondido, where I got an adult male May 29, and a young bird in first plumage June 5.

29. Geothlypis caninucha icterotis Ridgw.

Rather common on the Escondido. First specimen shot May 17. Next seen August 17, when an immature male was shot. Later it became quite common, and individuals were frequently heard. The note is loud and clear. The birds are found in the tall grass along the river banks. They may breed here, but if so are very retiring, as I saw none during the summer.

30. Icteria virens (Linn.).

Uncommon, apparently. First seen October 14, and specimen obtained at Greytown February 14.

31. Sylvania mitrata (Gmel.).

Very common. First seen September 24; taken at Greytown February 5.

32. Setophaga ruticilla (Linn.).

Very common; first seen September 20.

33. Basileuterus leucopygius Scl. and Salv.

Common on the Rio Frio in March. The bird has habits very similar to *Seiurus motacilla*, and its note is very much the same. Instead of jerking the tail up and down it flirts it continually after the manner of a Redstart (*Setophaga ruticilla*), and at times resembles this bird in habits more than the *Seiurus*. The song is loud and clear, and very melodious, resembling somewhat that of a Field Sparrow (*Spizella pusilla*), with several variations.

Found usually along streams, but often wanders into clearings, where it hops along fallen trees and on bare patches of ground. The birds were found almost invariably in pairs.

Family HIRUNDINIDÆ.

34. Progne subis hesperia Brewst.

A pair shot September 13 on the Escondido out of a flock of six or eight, which had settled in the top of a dead tree during a shower. This appears to be considerably south of the other records for this species.

35. **Progne chalybea** (Gmel.).

Abundant. Nests in holes in trees standing in the plantations, and also common in the town of Bluefields, where the birds use natural cavities in the breadfruit trees for nesting purposes. Young birds found from April to July. Later, the birds congregate in small flocks and fly about over the plantations and houses, occasionally circling about high in the air during sunny days. At times large flocks, mixed with *Tachycineta albilinea*, *Chelidon erythrogaster*, and others may be seen flying about, especially in the evening before sunset or on cloudy afternoons. The ordinary note resembles that of *P. subis*.

36. **Chelidon erythrogaster** (Bodd.).

Abundant in winter and during migrations. Arrive late in August, when they occur in large flocks, usually mixed with other species. In March large numbers were seen, probably migrating, and small numbers were seen as late as May 3.

37. **Tachycineta albilinea** (Lawr.).

Abundant, particularly on the Rio Frio, where there were many snags and stumps sticking out of the water, in the cavities of which the birds bred. Saw young birds early in May.

This species seldom or never occurs away from the rivers, where it flits back and forth, frequently perching on snags or dead limbs hanging out over the water.

38. **Stelgidopteryx uropygialis** (Lawr.).

Common on the Rio Frio in company with the preceding.

Collected by Wickham on his trip up the Escondido.

Family VIREONIDÆ.

39. **Vireo olivaceus** (Linn.).

One of a pair secured September 10.

40. **Vireo philadelphicus** (Cass.).

One shot October 21 was the only one observed.

41. **Vireo flavifrons** Vieill.

Rather common; first seen October 22 and last on February 8.

42. **Vireo ochraceus** Salv.

A pair secured in some bushes at Greytown, February 1, and one seen April 10, in the same vicinity.

My birds are in fresh unworn plumage, and almost as bright as *V. carmioli*. They agree very well with the description of the bird called

Vireo semiflavus by Salvin, which was probably a bird of this species in unusually bright plumage.

Measurements are as follows:

Number.	Locality.	Sex.	Wing.	Tail.*	Tarsus.	Culmen
126153	Greytown, Nicaragua	♂	2.00	1.62	0.75	0.45
126154	......do	♀	2.10	1.62	0.80	0.43

* All measurements are in inches and hundredths; the tail measurement is that of the longest tail feather from tip to point of insertion.

43. **Hylophilus decurtatus** (Bonap.).

Common at Greytown and on the Escondido River during the winter. Apparently not present during the summer, but was observed from August 28 and thereafter throughout the winter. It has a pleasing song; is usually found some distance up in the trees, although at Greytown it was found in low bushy thickets.

44. **Vireolanius pulchellus verticalis** Ridgw.

Not common. First observed September 28, and several times thereafter. It appears to be absent during the summer. In one of my specimens, a female, there is a well-defined and really conspicuous yellow rictal streak, the green over the eye is paler than usual, and faintly yellowish, forming a decided superciliary stripe. There are several yellow feathers posterior to the lores, and the abdomen is of a brighter yellow than in other specimens examined. In two other National Museum specimens from Guatemala there is a tendency to a light rictal streak and faint superciliary stripe.

Family CŒREBIDÆ.

45. **Dacnis ultramarina** Lawr.

One female, shot November 27 on the Escondido, was the only one seen.

46. **Chlorophanes spiza** (Linn.).

Very common on the Escondido. First seen September 26, and afterwards common. Feeds largely on ripe bananas. Has a loud, clear, shrill call of two syllables, like "twee-twee," which can be heard a long distance. Mixes with the other Honey Creepers quite freely.

Iris, burnt sienna; lower mandible, naples yellow.

47. **Arbelorhina cyanea** (Linn.).

Very common in flocks at San Carlos in February, feeding on trees having large crimson flowers. One shot on the Escondido May 17, and others found associating with *A. lucida* in November.

Feet and legs of adult male, vermilion; of female and immature birds, brownish vermilion.

48. Arbelorhina lucida (Scl. and Salv.).

Very abundant on the Escondido. First seen November 21, when several came into the house. Afterwards abundant, mixed with a few *Chlorophanes* and *A. cyanea*. The note is a weak chirp. These birds appeared to be attracted by the cocoanut and bread fruit trees. In almost every specimen shot the bill was covered with a waxy substance.

In the adult male the feet and legs are canary yellow; claws black; the females and young males have these parts sage green, but in the latter the colors begin to change with the plumage.

49. Cœreba mexicana (Scl.).

Common at Greytown and at the Guatusa Indian clearings on the Rio Frio. A pair started a nest at Greytown in a bread-fruit tree, but deserted it before finishing. The note is a rather weak, rapidly uttered chirp. Not seen on the Escondido.

Family TANAGRIDÆ.

50. Euphonia luteicapilla (Cab.).

One specimen secured September 28 on the Escondido.

51. Euphonia hirundinacea Bonap.

Not rare on the Escondido, where it haunts the banana plantations and feeds largely on the ripe fruit. Has a pleasing and somewhat varied song.

52. Euphonia gouldi Scl.

Occasionally seen in small companies on the Escondido and at Greytown. Does not appear to spend its time among the bananas like the preceding.

53. Calliste larvata DuBus.

Very common in small flocks. Immature birds obtained early in May. Feeds largely on ripe bananas, although at times it appears to search for insects in the Trumpet and other trees.

54. Tanagra cana Sw.

Abundant at Greytown and on the Escondido in pairs and small flocks. Feeds largely on ripe bananas and the berries of some trees. Has a prolonged squeaky note.

Ripe bananas prove a great attraction for many species. Bunches of the fruit are often cut down and allowed to rot in the plantations, and when "dead" ripe they draw most of the plantation birds, even species that are almost exclusively insect feeding, such as *Pitangus*.

55. Tanagra palmarum Weid.

One specimen shot at Greytown, February 6.

56. Ramphocelus passerinii Bonap.

With the single exception of *Sporophila corvina* this species is the most abundant in localities visited by me. It fairly swarms in all favorable situations, and is one of the first birds to impress the eye of a foreigner. The birds spend the day romping about in the bushes or in the banana plantations, chasing one another here and there, with no apparent reason other than to pass away the time. They keep up an almost continual squeaky chatter, which is the only note heard on ordinary occasions, but at times I have heard solitary males sing, if the performance may be called a song. It is a very inferior chant, much like the ordinary chatter, but uttered in a slow and measured way. Females appear to be much more numerous than males. The birds are perhaps not truly gregarious, although very social the year round, and may possibly be polygamous. In many ways these birds remind one of the House Sparrow (*Passer domesticus*). The birds show little feeling when robbed of nests and eggs. One partial albino was observed.

Nesting begins early, as young were found in the nest during the first week in March, and eggs were obtained as late as July 4. As in many other species in this region, the number of eggs and young found in a nest is two. The nests are placed in bushes or vines, from 1 to 5 feet from the ground, constructed of small stems of plants and dead leaves, and lined with fine grass stems. Eggs ovate, pale blue, marked chiefly on the large end with dark brown, almost black, spots, mottlings, or occasional pen lines, with a few indistinct pale lavender spots. Measurements of four clutches are as follows: 0.96 by 0.64, 0.94 by 0.64; 0.87 by 0.66, 0.88 by 0.67; 0.98 by 0.63, 0.98 by 0.64; 0.88 by 0.68, 0.90 by 0.68.

57. Phlogothraupis sanguineolenta (Less.).

Not rare on the Escondido and at Indian plantations on the Rio Frio. In habits it differs much from the preceding, being ordinarily rather shy and quiet. Rarely more than two are seen together, except in the fall, when there is a tendency to gather in small flocks. At this period there appears to be something of a migration of the species, or an influx of individuals from other localities, and the bird might then be said to be common. An increase in numbers was noticed late in August. The note is a rather shrill whistle; I did not hear the song. It occurs in banana plantations, in bamboos along streams, and in open places on the edge of the forest, but does not appear to frequent low bushes, as the above species is wont to do.

A nest found May 30 was in a cluster of vines on a banana plant, at a height of 8 feet. It was similar to that of *Ramphocelus*, but slightly larger, covered with living green moss, and lined with hair-like black stems. The eggs are pale blue, short ovate, sparsely spotted at the large end with brownish black spots, with occasional faint marks of lavender. They measure 0.91 by 0.71, 0.90 by 0.70. Iris reddish brown.

58. Piranga erythromelas Vieill.

Early in March I observed two adult males on the Rio Frio, and another on the Escondido September 27. These were in the scarlet and black plumage, and the only individuals of the species identified.

59. Piranga rubra (Linn.).

Very abundant during the winter. Males are found in various stages of plumage between that of the female and adult male. First seen late in October, when they shortly became common, and continued so until spring. Last seen April 13.

60. Phænicothraupis salvini Berl.

My specimens of this genus collected on the Escondido are referable to this form, although not typical, while a pair from Greytown, collected by Holland, are true *P. fuscicauda*. These localities are separated by a distance of only 60 or 70 miles.

These birds are gregarious and inhabit the forest; individuals are often found in company with Ant Thrushes and other birds, preying on the traveling ants. They are rather shy and the first to notice the approach of an intruder, when they move off to a position of safety, scolding in a harsh voice. Iris brown.

61. Phænicothraupis fuscicauda Cab.

Common on the Rio Frio. Habits similar to those of the above.

62. Tachyphonus luctuosus Lafr. & D'Orb.

Uncommon, occasionally met with in the forest on the Escondido, where they are found in the trees, above the undergrowth. Feet and legs light heliotrope purple.

63. Arremon aurantiirostris Lafr.

Very common on the Rio Frio, less so on the Escondido. While journeying up the former river I camped at night in the woods, where, at daybreak, the first signs of bird life were sure to be individuals of this species hopping about on the ground in open places, uttering an occasional sharp "chip," and at the least suspicious movement darting back into the dark recesses, from whence they would again appear after becoming reassured. I have never seen them above the bushes, while ordinarily they seem to prefer brush heaps and bare spots on the ground.

Bill orange-vermilion.

The nest is slightly raised from the ground, and is very bulky. It is constructed on a base of dead leaves, plant stems and other dry material being largely used; the lining is of fine light-colored stems and roots. The affair is roofed over like that of the Ovenbird (*Seiurus aurocapillus*) and covered with living ferns and mosses, which most effectually conceal it. Several visits were made to a nest before the

bird could be identified, owing to its extreme shyness and habit of stealing away on my approach. The eggs are two, elliptical ovate, with straggling spots of dark brown at the large end. Two eggs, taken from different nests, measure 0.95 by 0.65, 0.93 by 0.67.

64. Saltator atriceps Less.

One shot at Greytown February 3. This was the only individual positively identified, although the species may have been common.

65. Saltator magnoides Lafr.

Common in plantations and thickets along the streams.

66. Saltator grandis (Licht.).

Not identified at Greytown, but specimens were obtained near Bluefields, at San Carlos, and commonly on the Escondido. These birds feed on berries, ripe bananas, and other fruits. They are very restless.

67. Pitylus poliogaster scapularis Ridgw.

Common on the Rio Frio and on the Escondido. This *Pitylus* is gregarious; it inhabits the rather open parts and edges of the forests, and occasionally wanders into the banana plantations. The birds sing almost incessantly as they travel about in search of food. The song is short and jerky, and its resemblance to that of the Dickcissel (*Spiza americana*) very close. I saw birds with nesting material about the middle of May.

68. Pitylus grossus (Linn.).

Not common on the Escondido, where individuals were at times seen in the forest. It is rather shy, and does not appear to go in flocks like the preceding. The call note is similar to that of the Cardinal (*Cardinalis cardinalis*). The skin is very tender. Bill vermilion.

Family FRINGILLIDÆ.

69. Oryzoborus nuttingi Ridgw.

Not common; observed at Greytown and on the Escondido. It frequents the clearings and thickets around plantations and bordering the forest. The bill is usually flesh-color, occasionally black. I did not note anything further on its habits.

70. Oryzoborus funereus Scl.

Abundant at the International Planting Company's plantation on the Escondido, and probably at other places on that river; one specimen was taken at Greytown. It lives in precisely the same situations and resembles *Sporophila corvina* so closely that the two birds are difficult to distinguish at any distance, except by song, which, in this species is very like that of the Indigo Bunting (*Passerina cyanea*), but is not

nearly so loud and clear. At times, like *Sporophila corvina*, it seeks a perch in the top of a tree from which to deliver its song. Usually, however, it is content with the tall grass growing in the plantations and on the edge of the water, where it leads a careless life and finds an abundance of food.

A nest found June 14 was in a bush, 3 feet from the ground. It was made of fine weed stems, the inner part entirely of fine hair-like stems, lined with the same. Eggs, two, ovate, grayish white, finely spotted all over, particularly on the large end, with lavender, and over these small, irregular dark-brown markings. They measure 0.83 by 0.59, 0.78 by 0.58.

71. **Guiraca concreta** (Du Bus).

Rather common, especially in clearings, and thickets bordering the woods. The song is not very remarkable. On one occasion I found several of these birds a short distance in the woods behaving very suspiciously near a colony of army ants, but am unable to say whether they were preying on the ants or not.

72. **Sporophila corvina** (Scl.).

Extremely abundant, particularly on the Escondido, where it fairly swarms in all suitable situations, in the long grass and around clumps of bushes. It is very social and much like *Ramphocelus* in its habits.

In the *Centrali-Americana*, *Biologia Aves*, I, 356, referring to this species, the statement is made that "in Nicaragua alone it approaches the Pacific, having been found at Los Sábalos on the western shore of the Lake of Nicaragua." This is a mistake, as Los Sábalos is located on the San Juan, some miles east of the lake (Nutting gives it as about 35 miles). This hacienda is not shown on any map, but the Sábalos River, which gives the location exactly, empties into the San Juan from the north, and is named on most maps, I believe. The birds are abundant here, and also on the Rio Frio in favorable places.

The song of this species is a rapid chant, giving one the impression that the singer is in a hurry to finish and be off with the rest of its kind. The bird is quite a mimic, frequently bringing the notes of other species into various parts of its little performance. I have detected the notes of *Myiozetetes texensis*, *Crotophaga*, *Ramphocelus*, and others during one execution. At times the song appears to be composed almost entirely of the notes of other species. The common call is a "deé-ah," and reminds one of a note of *Spinus tristis*.

Breeding begins in May, as fresh eggs were found about the middle of the month. The nest is usually placed in a bush, though often in the grass, at heights varying from 2 to 8 feet. It is composed of fine stalks and grasses, lined with finer ones. Sometimes the nest is made of one material, without extra lining. The eggs are two; yellowish white, blotched with pale lavender, over which are heavy, though

sparse, markings of dark brown, chiefly at the larger end, sometimes forming a wreath, and mixed with occasional fine black spots. Two eggs measure 0.77 by 0.53, 0.74 by 0.53; another, 0.73 by 0.50.

73. **Volatinia splendens** (Vieill.).

One specimen, taken July 14, found in the tall grass on the river bank.

74. **Passerina cyanea** (Linn.).

Occasionally observed during the fall on the Escondido. First collected September 30, and a flock noticed October 23. All were in the plumage of the female.

75. **Embernagra striaticeps** Lafr.

Very common. Found in clearings, banana plantations, and similar places, where it prefers the vicinity of bushes, vine-covered banana plants, and other hiding places, to which it can retire if disturbed. The bird spends much of its time upon the ground, searching for food; and individuals were sometimes caught in traps set for small mammals. I have not heard this bird sing, but it has a low and rather plaintive chirp. A nest found May 6 was in a fan palm leaf, about 3 feet from the ground. It was quite a bulky affair, roofed over and composed of strips of dead leaves and weed stalks, lined with fine stems and grasses. The base of the nest was tenanted by a colony of black ants. Several visits were made to the nest before the bird could be identified, owing to its retiring way. The eggs were two, ovate, pure white, measuring 0.93 by 0.69, 0.96 by 0.69. Another nest, found the same day, contained small young, and was in a citrus tree, about 5 feet from the ground. It was not so bulky as the first.

Family ICTERIDÆ.

76. **Eucorystes wagleri** (Gray).

Noted at various places on the San Juan and Rio Frio; one specimen shot on the Escondido.

A colony observed nest-building on the Rio Frio early in March. The actual work of securing material and constructing the nests seemed to fall upon the females, the males merely accompanying them back and forth on these occasions. A dead tree standing in the open, containing a hornet's next, had been selected by the birds, and about fifty nests were suspended from the extremities of the branches. These were nearly finished, and various nests on the ground testified to the overburdening of some of the smaller branches. I did not hear any song, but the birds kept up a low chuckling note as they flew to and from the tree. The amount of energy and diligence displayed by the birds in building these nests is truly remarkable, when one considers the time wasted by many birds in nest-building.

77. **Gymnostinops montezumæ** (Less.).

Very common. Gregarious at all times and breeds in communities, the birds selecting a solitary dead tree, as in the case of *Eucorystes*, generally with a hornet's nest in it, where the peculiar pendulous nests, over 3 feet in length, are suspended from the branches, presenting a very conspicuous appearance.

At these colonies many apparently old nests are found on the ground, having been attached to branches unable to bear the strain, or possibly blown down by the wind. Nests occupied at the time were found late in April, and nest-building was noticed early in January. During the summer the birds are rather retiring, and only occasionally met with in the woods, but late in the fall and throughout the winter they are very conspicuous, visiting the large ebo and other trees in the plantations, or passing overhead from one feeding place to another. The flight is slow and labored, and recalls that of a crow; the birds also have a habit of flying in an unsteady stream when moving from one place to another in numbers, instead of going in a flock. The ordinary note is frequently uttered, but, like the song of this species, is most difficult to describe. The song is a gurgling sound, rapidly ascending the scale, and simultaneously with it another note is uttered resembling the shrill squeaking of a hinge or wagon wheel in need of attention. The attitude of the bird in the act of singing is also remarkable. When about to deliver its notes it makes a profound bow, bringing the head below the level of its perch, at the same time raising the tail to a vertical position. While singing the bird gradually resumes its normal position. It sings at frequent intervals for a half hour or more, and when not thus engaged sits dressing its feathers or hops leisurely about. It is worth mentioning that in every case that came under my notice the bird, during its singing spell, was alone.

Iris dark brown; terminal half of bill chrome-orange, remainder black; naked skin on side of head flesh color, with faint bluish tinge.

78. **Amblycercus holosericeus** (Licht.).

Common; occurs mostly in clearings and banana plantations, but is met with occasionally in more open places in the woods. It is gregarious to some extent, as small flocks of six or eight are commonly observed traveling about in search of food. Clumps of bamboo and thickets of "wild plantain" (*Heliconia*) are favorite resorts of this species. It spends much time investigating the dead leaves hanging from banana plants, shaking and rattling them as if to frighten insects from their hiding places. Ordinarily quiet and rather retiring, it is possessed of considerable curiosity, and can be called up without any difficulty by imitating its note or the cry of a bird in distress, when it scolds one in a harsh voice, the note much resembling that of a Magpie. Several times while trying to entice more desirable birds from the thick underbrush have I been surrounded by individuals of this spe-

cies, who immediately began to scold loudly, with the result of frightening other birds away. This species is the author of various whistling notes, that are difficult to identify before one has become well acquainted with the bird, owing to its retiring disposition. On one occasion, having wounded one of these birds, it escaped into the thick brush, where I was unable to reach it. Another individual flew into a bush close by and began to whistle, when the injured one hopped out from its place of concealment and answered the calls of the newcomer with an entirely different whistle.

Iris varies from Naples yellow to almost white; feet plumbeous.

79. Cassicus microrhynchus (Scl. and Salv.).

Common. These birds are gregarious part of the year, but go in pairs during the breeding season. The nest is somewhat over a foot in length, constructed of the same materials and resembling in shape the nest of *Gymnostinops*. The birds do not appear to select isolated trees, as in the case of the Yellow-tails, nor do they nest in communities. A pair was noticed building late in February in the top of a large forest tree. One of the birds, probably the female, attended to the nest-building, while the other escorted it to and from the nest, singing a few lines while material was being arranged in the nest. The song resembles notes occasionally uttered by the American Robin (*Merula migratoria*). These birds appear to have some particular roosting place, to which they resort each night, when not occupied with nesting cares. A small flock of seven or eight used to pass over the plantation each evening, drop into a tree for a moment or so, then off toward the woods, where they spent the night. When flying they make a whirring noise with the wings.

This is a forest species, keeping usually to the high trees, but often found among the lower branches searching for food in company with *Phœnicothraupis* and other birds.

Iris pale blue; feet black.

80. Icterus prosthemelas (Strickl.).

Common in banana plantations on the Escondido. Although this bird was observed almost daily for over eight months, I failed to hear its song; the only note detected was a chirp similar to that of the House Sparrow (*Passer domesticus*).

81. Icterus mesomelas (Wagl.).

The common Oriole of the country. Confined to clearings, especially banana plantations, where it is known as "Banana Bird" to all the English-speaking people. It has a loud, clear song, with several variations. The bird is something of a ventriloquist at times, beginning its song in a low tone, as if far away, and gradually leading up to its

full volume, when one discovers the bird close at hand, instead of far away in the plantation, as at first supposed.

The nest did not come under my observation, but young birds were frequently met with; two young, hardly able to fly, were found June 22.

82. **Icterus spurius** (Linn.).

Common in winter. First seen August 20, and last observed on February 23. This and the following species occur here mostly in small flocks of from five to eight, sometimes both species in the same company. They do not seek their food among the banana plants after the manner of the native species, but prefer open, spreading trees in the plantations, bamboos, and fruit trees.

83. **Icterus galbula** (Linn.).

Common in winter. Noted from September 20 to February 16.

84. **Callothrus robustus** (Cab.).

One specimen taken at San Carlos, from a flock of the following species.

85. **Agelaius phœniceus** (Linn.).

Common at San Carlos and in marshy places on the Rio Frio. Not enough specimens were preserved to decide whether this or *sonoriensis* was the form occurring there.

86. **Dolichonyx oryzivorus** (Linn.).

Observed flying over, October 10, on the Escondido. Heard several times late in August and September.

87. **Quiscalus macrourus** Swains.

Common at San Carlos and Bluefields; not observed at Greytown. Several times during my stay at San Carlos I saw what appeared to be individuals of the recently described *Quiscalus nicaraguensis* Salv. and Godm. mingling with the above species at the wharf and along the lake shore, but shooting was prohibited within the town and no specimens were secured.

88. **Cassidix oryzivora** (Gmel.).

Not common. Observed a few times on the Escondido.

Family FURNARIIDÆ.

89. **Synallaxis pudica** Scl.

Very common at Greytown and quite so on the Escondido. Almost always in pairs. At Greytown the birds were most commonly found in brush piles, prospecting for food, and on being approached would seek the recesses of the pile rather than escape by flying to some other

place of safety, chattering rather harshly at being interfered with. They also have notes of one or two syllables, but although I observed them on many occasions and noted their habits minutely I never heard the song which Mr. Nutting speaks of (Proc. U. S. National Museum, VI, 1883, p. 404), and am inclined to think some mistake was made when he gave this bird credit for a song. On the Escondido the birds are often found in the dense masses of vines and parasitic plants attached to the trunks of trees standing in the plantations, in which they find favorable places for concealment. It is an easy matter to bring one of these birds out into plain sight by squeaking, as they show much curiosity. In their habits they resemble the Wrens, but exhibit less nervousness than those birds.

The nest is built in a bush, from 3 to 5 feet from the ground. It resembles a retort to some extent, in having a bowl with a neck at the top slanting downward. The nest is made of small thorny sticks closely laced together; the neck or entrance is built out and downward until it is below the level of the body of the nest. Sometimes this covered way is not very well defined, being lost in the mass of sticks. The nest is so compactly put together that it is not an easy matter to open it bare-handed. The species appears to go much better with this family than with the *Dendrocolaptidæ*, where it has long been placed.

Iris reddish brown.

Family DENDROCOLAPTIDÆ.

90. Automolus pallidigularis Lawr.

Common in the woods on the Escondido. Does not cling to the trunk of a tree, but hops about and perches somewhat like a Robin. Its note very much resembles that of the Red-breasted Nuthatch (*Sitta canadensis*). It passes much of its time searching in the rubbish that gathers on the broad palm leaves.

My specimens appear to be *pallidigularis*, although probably not typical. In two examples the under parts agree exactly in color with *cervinigularis* from Guatemala, marked "Compared with type."

91. Xenops genibarbis Ill.

One individual shot in the forest near Castillo. It was hopping about in a tree, some distance from the ground.

92. Glyphorhynchus cuneatus (Licht.).

This was the most abundant species of the family in the forest region embraced in this paper. Usually found in pairs. It climbs like a Woodpecker, frequently uttering its sharp "chip," sometimes a rapid succession of "chips." The bird is very tame and unsuspicious.

A nest found May 26 was in a small, natural cavity at the foot of a tree, not more than 10 inches from the ground, and the nest itself was level with, if not below, the ground. The eggs, two in number, were

pure white, short ovate, and blunt at both ends. They measure 0.75 by 0.61, 0.73 by 0.60.

Notwithstanding the fact that the eggs were somewhat incubated, the bird was engaged in carrying tufts of fine roots to the nest at the time of its discovery. When surprised on the nest it would fly to the nearest tree and cling to the trunk, where it remained perfectly motionless, and allowed me to pass within a short distance of it. This performance was repeated several times, always with the same result, the bird evidently relying on its dull color and silence for protection.

93. Dendrocolaptes sancti-thomæ (Lafr.).

Occasionally seen on the Escondido. It is sometimes attracted by the armies of ants, where it mixes with the other species of Creepers and Ant Thrushes.

94. Dendrornis nana Lawr.

Quite common in the woods on the Escondido. This bird is usually found in the forest, but one pair was observed at Greytown on the trunk of a cocanut tree, some distance from heavy timber. I fail to recognize the form *costaricensis* Ridgw. My specimens present considerable variation in size and color.

95. Dendrornis lacrymosa Lawr.

I did not meet with this species, but Wickham collected it on the Escondido.

96. Picolaptes compressus (Cab.).

Two specimens taken at San Carlos. They were climbing a solitary tree, located in a marshy spot, some distance from the woods.

97. Dendrocincla anabatina Scl.

Observed several times on the Escondido, with armies of foraging ants. This and the following species were shot from the same tree, in one instance. Note, a querulous chirp, frequently uttered. Iris dark brown.

98. Dendrocincla olivacea Lawr.

One specimen shot from a company of ant-eating birds on the Escondido. Iris dark brown.

99. Sclerurus guatemalensis (Hartl.).

One shot on the Escondido. A pair of the birds was found on the ground in the deep woods.

Family FORMICARIIDÆ.

100. Cymbilanius lineatus fasciatus Ridgw.

Common; found in the forest, in trees, usually from 10 to 20 feet from the ground. Has a chattering note of several syllables, rapidly uttered. Females appear to be rather retiring, and fall under observation much less frequently than males.

When Mr. Ridgway described this subspecies* he had only one bird

*Proceedings U. S. National Museum, vi, 1883, 404, April 11, 1884.

from South America, a Cayenne female. His description has reference only to the female, and when applied to the male the differences pointed out by him are somewhat misleading, as in the latter the chief dissimilarity is observed on the under parts. Since that time the National Museum has acquired four males from Diamantina, Brazil, and others of both sexes, from Nicaragua and Costa Rica. A careful examination of this series leads me to believe that the northern birds are easily separable from the South American ones.

Granting that the Cayenne female is a typical one of the South American form, and I have reason to think it is, the difference between it and the Central American birds is at once apparent. The bars on the upper parts are much narrower and paler than in the latter, and, while the under parts are nearly the same as regards width of bars, there is a very strong suffusion of buff in the Central American examples. In males the difference between the bars on the upper parts is hardly distinguishable, but there is a decided difference below, the black and white spaces being considerably wider in *fasciatus*. The statement made in *Biologia Centrali-Americana, Aves*, II, 195, that the variation in the width of the white bands is probably due to age, the birds with narrower bands being the older, is disproved by two males from Diamantina, in which the wings are similar in color to those of the female, a mark of immaturity. These birds differ in no way from the other Diamantina males as regards barring of the under parts. There is a difference in size alone sufficient to warrant the separation of the two forms, as an examination of the following table will show:

CYMBILANIUS LINEATUS.

Number.	Collection.	Locality.	Sex.	Bill from nostril.	Wing.	Longest tail feather.
112275	U. S. N. M	Diamantina, Brazil	♂	0.52	2.82	2.67
120940	...do	...do	♂	.54	2.82	2.77
120941	...do	...do	♂	.52	2.84	3.01
120942	...do	...do	♂	.52	2.80	2.95
32823	...do	Cayenne	♀	.52	2.80	2.70

CYMBILANIUS LINEATUS FASCIATUS.

Number.	Collection.	Locality.	Sex.	Bill from nostril.	Wing.	Longest tail feather.
91251	U. S. N. M	Type. Los Sábalos, Nicaragua	♂	0.60	3.00	2.72
128338	...do	Escondido River, Nicaragua	♂	.61	2.90	2.77
128339	...do	...do	♂	.58	2.90	2.78
4103	C. W. R	...do	♂	.60	2.98	2.80
4295	...do	...do	♂	.62	2.85	2.65
4408	...do	...do	♂	.61	2.98	2.77
126320	U. S. N. M	Rio Frio, Costa Rica	♂	.62	2.89	2.67
91840	...do	Rio Sucio, Costa Rica	♂	.59	2.90	2.71
64769	...do	Sipurio, Costa Rica	♂	.61	2.93	2.70
34775	...do	Angostura, Costa Rica	♂	......	2.90	2.66
45615	...do	Sta. Fé, Veragua	♂	.59	2.90	2.75
53801	...do	Panama	♂	.60	2.90	2.82
91252	...do	Type. Los Sábalos, Nicaragua	♀	.67	2.90	2.72
128340	...do	Escondido River, Nicaragua	♀	.58	2.93	2.82
128341	...do	...do	♀	.60	2.93	2.77
4467	C. W. R	...do	♀	.60	2.85	2.75
4538	...do	...do	♀	.60	2.93	2.93
116345	U. S. N. M	Nicaragua	♀	.60	2.90	2.76
64770	...do	Sipurio, Costa Rica	♀	.57	2.88	2.81
34774	...do	Angostura, Costa Rica	♀	.58	3.00	2.87
53807	...do	Panama	♀	.58	2.80	2.75

Iris carmine.

101. **Thamnophilus melanocrissus** Scl.

Very common. This species is found in thickets bordering the forest, in patches of bushes in clearings, in clumps of bamboo along the banks of streams, and in similar places. It is often seen on the ground in these situations, searching for insect food. The song of this bird is heard at frequent intervals during the greater part of the day. The performance is a repetition of notes, rapidly uttered, in one key, with a slight pause after the first and second syllables. "Took, took, tu-tu-tu-tu-tu-tu-took, wah," resembles it about as closely as it is possible to give it in print. The last syllable, "wah" is very harsh and guttural, and is heard only when one is very close to the bird. When singing, the bird usually seeks a perch above its surroundings, a bamboo, or the top of a bush, where it often remains for a considerable length of time, uttering its monotonous notes in answer to those of other individuals of the same species within hearing. It is rather shy under these circumstances, and on being approached drops into the bushes, where it remains perfectly quiet until all danger is over. On other occasions, when in the bushes, although in plain sight, the bird may be approached very closely without its showing any uneasiness.

The majority of males collected by me on the Escondido have white edgings to the feathers of the under tail coverts, some of them fully as much so as in *T. transandeanus*. Specimens in the National Museum from the north coast of Honduras have these feathers plainly edged with white, in one specimen to such an extent as to give it the appearance of *T. melanurus*. The wing coverts in all of these specimens are conspicuously tipped with white.

Iris geranium red; bill black; feet and tarsi light plumbeous.

102. **Thamnophilus atrinucha** Salv. and Godm.

Three specimens secured on the Escondido. They were all found in the forest some distance up in the trees; one of them was at least 80 feet from the ground when shot. Sometimes seen with *Formicivora boucardi* inspecting the palm leaves, and searching in the masses of rubbish which accumulate in such places.

Iris brown.

103. **Thamnophilus doliatus** (Linn.).

Common. This species inhabits the same situations, and its song and habits are very similar to *T. melanocrissus*. When anything happens to arouse its curiosity or startle it the crest is raised.

Mr. Cherrie states (Auk, IX, 1892, 250) that this species occurs only on the Pacific side of Costa Rica. It is quite probable, however, that the species will be found on the Atlantic coast also, as the bird is common at Greytown.

Iris noted in different specimens as yellowish white and greyish white; feet bluish plumbeous.

104. **Myrmotherula fulviventris** Lawr.

One specimen shot in the forest on the Escondido, July 2. This was the only one observed. It was hopping about in a tree after the manner of a *Formicivora*.

105. **Myrmotherula melæna** (Scl.).

One shot in the woods on the Rio Frio. It resembled *Formicivora* in its actions.

Feet and claws pale bluish plumbeous.

106. **Cercomacra tyrannina** Scl.

Very common on the Escondido. One of the Ant Thrushes most frequently seen. Found in bushy places or in low trees in the forest, where it keeps concealed and often utters its chattering note. Almost always found in pairs, but occasionally noticed roving about with *Formicivora* and other species.

107. **Formicivora boucardi** Scl.

Common on the Escondido. It keeps in the trees some distance from the ground. Sometimes seen in flocks of fifteen or so in company with other species, searching the palm leaves for food, reminding one of a troop of Kinglets or Titmice to some extent.

108. **Ramphocænus rufiventris** (Bonap.).

This curious little bird is rather common at Greytown, where it passes its time in the bushy thickets. On the Escondido it is often met with in the forest, hopping about in the thick undergrowth, seldom getting more than a few feet above the ground. It is usually quick and Wren-like in its movements, but at times acts very leisurely, scrutinizing its surroundings in search of insect food, very much after the fashion of a Vireo. It is a quiet, unsuspicious bird, rarely uttering a note of any kind, or manifesting uneasiness at the proximity of an unusual object.

109. **Gymnopithys olivascens** (Ridgw.).

Uncommon on the Escondido. Apparently confined to the thick undergrowth of the forest, usually found associating with other species of the family, attending the hordes of army ants. Shy and retiring.

Naked skin around eyes pale blue; iris dark crimson; tarsi, feet, and claws dark plumbeous; upper mandible black.

110. **Gymnocichla chiroleuca** Scl. and Salv.

Quite a common species on the Escondido, where it frequents the undergrowth in the deep woods. Being a shy bird, it is more often heard than seen, keeping well concealed, and flying hurriedly from one clump of bushes to another during its travels in search of food. It is doubtless gregarious to some extent, as the birds are generally found

in small companies of five or six. The note is a loud, ringing whistle, like "cheé-oo, cheé-oo, cheé-oo," resembling that of the Cardinal (*Cardinalis*) not a little. The birds call every few moments in reply to their companions, while wandering about. This note is also used during excitement or when scolding. It is one of the species most frequently found in the vicinity of traveling ants.

Bill, tarsi, feet, and claws plumbeous; naked skin of head azure blue, campanula-blue posterior to the eyes; iris dark crimson.

111. **Myrmelastes lawrencei** (Salv. and Godm.).

An adult male of this rare species was shot in the forest of the Escondido, September 7. It was found in a locality where *Gymnocichla chiroleuca* was common, and it probably has similar habits. This is, I believe, the first record for the species north of Panama.

The skin on the head is colored as in *Gymnocichla*, but is only noticeable on raising the feathers.

112. **Myrmelastes intermedius** (Cherrie).

Met with on two occasions on the Escondido. Found in bushes in the forest. Rather shy, and difficult to secure. This bird has a rather pleasing call of several syllables. Skin on head colored as in the above species.

113. **Hypocnemis nævioides** (Lafr.).

Uncommon. Habits similar to those of *Gymnopithys*.

114. **Formicarius hoffmanni** (Cab.).

Common on the Escondido, where its lonely call may be heard in the woods at any time. This species passes its entire time upon the ground in the more retired parts of the forest, using its wings only when suddenly surprised. It is an easy matter to call the bird up by imitating its whistle, and under these circumstances, if alarmed, will take wing and fly far enough to enable it to escape. If one falls in with a bird while traveling through the woods, it sneaks quietly away without resorting to flight, unless a suspicious movement is made. On one occasion I watched an individual for several moments while it was perched on a large vine a few inches above-ground, calling at regular intervals. It soon discovered me, when it jumped to the ground and walked rapidly away.

115. **Phlogopsis macleannani** (Lawr.).

Common in the woods on the Escondido. I saw them almost invariably with the armies of foraging ants, and, when disturbed, they quickly made off through the underbrush, uttering their curious, low, rambling notes.

Naked skin on head azure blue, campanula-blue back of eyes; iris reddish brown; bill black; tarsi, feet, and claws pinkish vinaceous.

Those familiar with Mr. Thomas Belt's "Naturalist in Nicaragua," have no doubt been impressed with his accounts of the habits of the various species of ants, and his observations on the Ant Thrushes and other birds usually found with the Escitons, or army ants. My experience with the Ant Thrushes habitually attending armies of ants leads me to disagree with the following statement in this book (p. 20) insomuch as it bears on the food of these birds: "Several species of ant-thrushes always accompany the army ants in the forest. They do not, however, feed on the ants, but on the insects they disturb. Besides the ant-thrushes, trogons, creepers, and a variety of other birds are often seen on the branches of trees above where an ant army is foraging below, pursuing and catching the insects that fly up."

I did not examine the stomachs of any of these birds, a circumstance I now regret very much, but ants were found in the mouths of some birds shot, which, while not proving positively that they were intended as food, strengthens a belief in that direction, especially when backed by other observations to the same effect.

In traveling through the woods one becomes aware of the proximity of hordes of ants, either by walking into their midst and receiving the information direct from the ants themselves, or by the medley of bird notes proceeding from the scene of activity. If the birds are approached quietly they will be found mostly close to the ground, and, as far as the Ant Thrushes are concerned, hidden in the thick bushes, on which and the ground the ants are swarming. On being discovered the various species make off through the underbrush in a guilty way, the Creepers begin an industrious search for insects on the trunks of neighboring trees, and each bird calls in its own peculiar manner, as if to disclaim any responsibility in the affair. The Creepers, or Ruby-crowned Tanagers (*Phœnicothraupis*), if present, are usually the first to notice an intruder and give the alarm. Various species of forest birds, hardly to be expected in these assemblages, are often found, joining in the scolding, and giving one the impression that they have been drawn into a discussion without knowing why. These latter birds do not appear, in most cases, to feed on the ants, but on the insects in the bushes and trees overhead. Four species of Ant Thrushes I invariably found with these columns of ants, *Gymnocichla chiroleuca*, *Phlogopsis macleannani*, *Hypocnemis nævioides*, and *Gymnopithys olivascens*, named in the order of their abundance. Señor Alfaro, director of the Museo Nacional, San José, Costa Rica, tells me that he has examined the stomachs of these birds and found them to contain ants.

Occasionally another species of ant is met with in the forest; this one travels in a narrow trail from 4 to 6 inches wide, instead of 20 or more feet, as in the case of the other, and, moreover, the trail is bare of everything, all obstructions having been removed. Birds accompanying these ants can not be feeding on insects disturbed by the latter, for none are started from the path; yet I have found the four spe-

cies of birds just mentioned in attendance upon these ants at various times, evidently for the purpose of feeding on the ants themselves.

I do not think any of the other Ant Thrushes met with by me feed on ants, except possibly *Myrmelastes*, *Formicarius*, and *Grallaria*. The first of these probably is an ant-eater, but I saw it only on three occasions and am not able to say positively.

116. **Grallaria dives** Salv.

One specimen shot in September, on the Escondido. It was walking about on the ground, and on my approach flew into a low bush. I did not hear its note.

Family TYRANNIDÆ.

117. **Copurus leuconotus** Lafr.

Common. Has a marked preference for dead trees in plantations and clearings, or dead limbs of living trees, in which the nest is usually located. The birds are almost invariably found close to the cavity in which their nest is placed, during the breeding season at any rate, frequently leaving their perches to fly out after a passing insect, after which returning to the same spot. The note is characteristic, shrill and prolonged, but rather weak.

118. **Todirostrum cinereum** (Linn.).

Abundant. Has a sharp, explosive note of three or four syllables, giving one the impression that it is a much larger bird than is really the case. My experience with the bird and its nest agrees very well with that of Mr. Cherrie, who has given a description of the nest and eggs in the Auk, VII, 1890, 233. According to my observations, however, the bird is not restricted to the banks of streams, although it shows a decided preference for such places. All of the nests found by me were in perfectly exposed situations and resembled bunches of drift grass. My first nest of this Flycatcher was found purely by accident. While exploring a busy tract, much frequented by this species, my attention was drawn to a small bird with disheveled plumage, which was darting at a *Synallaxis pudica*, accompanying its attacks by a hissing note. The attitude of the pugnacious little bird was striking, its tail was elevated and fully spread, and at every movement of the bird was switched from side to side in an angry way. With such a formidable appearance and spirited attack the intruder was soon driven off. The victor, which proved to be a *Todirostrum cinereum*, then hopped out toward the end of a branch and disappeared into what I had supposed to be an accidental tuft of dead grass and leaves. This I found to be its nest, a very compact structure, though ragged in appearance, with a hidden entrance in the side just large enough to admit the bird.

Eggs two or three, pure white. Three eggs, found March 31, measure 0.65 by 0.45, 0.65 by 0.46, 0.65 by 0.46. Two other eggs are 0.63 by 0.43, 0.71 by 0.41.

Iris pale yellow, almost white; feet bluish plumbeous.

119. Todirostrum schistaceiceps Scl.

Rather common. Not seen during summer, but specimens obtained August 30, after which date it was common. At Greytown this species and *T. cinereum* are found in much the same places, but, while the latter is bold and defiant in its actions and notes, this bird is quiet and retiring; I did not hear it utter a note at any time. On the Escondido it was observed in open places in the forest, where it kept in the undergrowth.

120. Oncostoma cinereigulare Scl.

As in the case of the above species, it was only observed during fall and winter. In its actions and choice of feeding places it also resembles that bird. First taken September 4.

121. Mionectes oleagineus assimilis (Scl.).

Not common. A specimen taken at Greytown and two others on the Escondido, one of which flew into the house. These were noted during fall and winter.

122. Capsiempis flaveola (Licht.).

Common in bamboos on the Escondido, and in bushy thickets in the vicinity of San Carlos. Taken also at Greytown. Has a weak note which it frequently utters while searching for food. It is very industrious, almost constantly on the move, though acting in a leisurely manner. Numerous deserted nests found in the bamboos probably belonged to this species. They were shallow structures, attached to forks at the extremities of the bamboos, covered outwardly with green moss, and usually suspended over water. An immature bird differs from the adult in being lemon yellow below, instead of canary yellow; wing bars yellowish buff; tail tipped with yellowish buff; feathers of back, upper tail coverts, crown, and hind neck also edged with the same color.

123. Tyrannulus semiflavus Scl. and Salv.

One specimen collected in some low bushes in open woods on the Escondido, September 7.

124. Tyranniscus parvus Lawr.

Common at Greytown in bushy thickets, and on the Escondido, where it was found high up in the forest trees in open places. The stomach of one individual examined was filled with small green seeds.

125. Elainea pagana subpagana (Scl. and Salv.).

Common at Greytown and on the Escondido. Resembles *Myiarchus* in habits, but prefers clearings, in the vicinity of thickets. I did not notice it in the woods at any time.

126. Myiopagis placens (Scl.).

Common in bushes and thickets in the neighborhood of San Carlos.

127. Myiozetetes texensis (Giraud).

Very common everywhere in the vicinity of streams. Saw fully fledged young on May 14, and found fresh eggs the same day.

128. Myiozetetes granadensis Lawr.

Common on the Escondido. One bird shot from a bamboo fell into the water, and before I could paddle to it a lizard ran out and dragged it to the bank, whereupon he dropped it and disappeared in some brush.

129. Rhynchocyclus cinereiceps (Scl.).

One specimen secured near Greytown.

130. Pitangus derbianus (Kaup).

Common. Called "Kiskadee" by the natives. Confined to the banks of water courses.

131. Myiodynastes luteiventris Bonap.

One of a pair shot on the Escondido.

132. Megarhynchus pitangua (Linn.).

Common, usually in pairs. Note is a harsh chatter. Not so partial to river banks as *Pitangus*.

133. Muscivora mexicana Scl.

Two specimens taken on the Escondido in September and October. The crest was not noticed in either case until the bird was shot.

134. Myiobius fulvigularis Salv. and Godm.

Shot a specimen on the San Juan, near Castillo, and took another far up the Rio Frio, where others were observed. It is found in the forest trees some distance from the ground, and makes a whirring noise with its wings while flying.

135. Empidonax pusillus traillii (Aud.).

Common on the Escondido and at San Carlos during the winter. Taken in fall as early as September 4, and in the spring until May 6.

136. Empidonax flaviv ntris Baird.

Several taken on the Escondido; first noticed October 22.

137. Empidonax acadicus (Gmel.).

A specimen was taken on the Escondido October 22. *Empidonaces* were common during the fall, and I probably missed noting some of the species, as attention was directed more to other birds.

138. **Contopus virens** (Linn.).

A common migrant; but few seen during the winter months. First heard August 21, and a few days later its familiar whistle was frequently heard. It was very abundant September 27.

139. **Contopus brachytarsus** Scl.

Common at San Carlos, but rather less so on the Escondido. An immature specimen taken in July has a very dark, almost pure black pileum. This specimen and others collected in February and March, in fresh, unworn plumage, have a very decided wash of straw-yellow on the under parts. This species prefers clearings and thickets. I did not at any time observe it in the forest country. Its note is weak.

140. **Myiarchus crinitus** (Linn.).

One specimen secured October 14 on the Escondido.

141. **Myiarchus lawrencei nigricapillus** (Cab.).

Very common; found mostly in clearings and bushy thickets; occasionally in open places in the forest. Note very weak.

142. **Tyrannus melancholicus satrapa** (Licht.).

Abundant at all times. Young birds fully fledged were found May 14. In a marshy spot on the Escondido, where dead trees and isolated bushes abounded, this species was exceedingly abundant. It is rather difficult to get good specimens, most of those shot being either in very worn plumage or molting.

143. **Tyrannus tyrannus** (Linn.).

A migrant. First seen September 8, when a small company of six or so was seen. A flock of over a hundred was observed on the morning of September 15. The birds dropped into a large tree on the plantation, and, judging from their movements, started in at once to satisfy their hunger.

144. **Tyrannus dominicensis** (Gmel.).

Rather common at Greytown for a short time late in March.

Family COTINGIDÆ.

145. **Tityra personata** Jard. and Selby.

Common. Usually found in small flocks in clearings, where dead trees abound. This bird has a very curious note—a low, gurgling sound, as if it were trying to clear its throat, sometimes hardly audible when the bird is in a high tree. The birds are occasionally given to playfulness, and chase one another lazily around the top of a tree, apparently with no desire on the part of the pursuer to overtake the object of its chase, but merely to keep it on the move. Breeds in holes in

trees. Feeds on fruits and berries, and possibly also on insects. Iris light brown; terminal third of bill black; remainder dull rose-purple; naked space around eyes purplish carmine.

146. Tityra albitorques frazeri Kaup.

Three individuals were shot out of a dead tree on the "I. P." plantation May 18. Two of these birds were females, one of which would shortly have deposited an egg. The species was not observed elsewhere.

147. Pachyramphus cinereiventris Scl.

Species taken at Greytown and on the Escondido. A nest found at Greytown April 14 was in an orange tree about 12 feet from the ground. It was rather bulky, composed of grasses and stems of various plants, with an entrance near the top. It contained three eggs, of a grayish color, obscurely mottled or blotched. The eggs were lost, and this description is entirely from memory.

148. Pachyramphus cinnamomeus Lawr.

Rather common.

149. Lathria unirufa (Scl.).

Uncommon; noted in the forests on the Escondido.

150. Laniocera rufescens (Scl.).

One wandered into the house, on the Escondido, early in January, and was the only one noted.

This specimen, and one from Honduras (Segovia River), both males, are appreciably darker than an individual from Panama, and another from Costa Rica (Barranca). In the two former the indistinct dark edging of the feathers of the under parts extends throughout, including the under tail coverts in the Nicaraguan specimen, while in the Panama and Costa Rican examples this edging is obsolete on the abdomen. The Honduras bird is recently adult, with signs of immaturity still apparent. The tertials and rectrices are tipped with tawny-ochraceous. The feathers of the greater and of some of the middle wing coverts are conspicuously edged with black. There are also two or three blackish feathers on the belly. The northern birds are somewhat larger, as the following table will show:

Number.	Collection.	Locality.	Sex.	Exposed culmen.	Wing.	Tail.	Tarsus.
112176	U. S. N. M ..	Segovia River, Honduras	♂	0.69	4.40	3.55	0.85
4748	C. W. R.....	Escondido River, Nicaragua	♂	.70	4.30	3.35	.85
41430	U. S. N. M ..	Barranca, Costa Rica	♂	.60	4.45	3.25	.81
53762	....do	Panama	♂	.61	4.45	3.25	.80

151. Lipaugus holerythrus Scl. and Salv.

Several taken on the Rio Frio, but not noticed elsewhere. Wickham found this species on the Escondido. Raises its crest when disturbed.

152. Attila citreopygius (Bonap.).

Two specimens secured on the Escondido agree in a general way with others of this variable species. These were taken in rather open woods, and resembled Flycatchers in their actions. Iris brownish carmine.

153. Pipra mentalis Scl.

Rather common in the forest on the Escondido. Usually found traveling about in small numbers. I once saw a male in a lemon bush, half a mile from any timber. Two came into the house. Iris of adult male, white; feet and legs Isabella color.

154. Manacus candæi (Parzud.).

Very common in the forest. Sometimes a flock of twenty or more males are found assembled in the low bushes, apparently after food. When flying the birds make a buzzing with the wings, and on alighting often make a noise similar to the cracking of a small twig, or of a Peccary gnashing its teeth. Feet orange.

155. Carpodectes nitidus Salv.

This species is common on the Rio Frio in Costa Rica. During a trip up that river, from February 26 to March 10, I found the birds numerous, from a few miles from the mouth to a point about 3 miles below the Guatusa Indian villages, far up the river. The birds were observed daily, passing over the river high above the trees, with steady flight and regular wing-beats. Most of the birds seen on these occasions were males. My first specimen was a female, found near the edge of the forest in a small berry-laden tree. The berries of this tree proved a great attraction to various species. During two or three visits to the tree I noticed the following, not all of them were feeding on the berries, however: *Piranga rubra*, *Myiobius fulvigularis*, *Tityra personata*, *Pachyramphus cinnamomeus*, *Manacus candæi*, *Lipaugus holerythrus*, *Carpodectes nitidus*, *Trogon massena*, *T. melanocephalus* *T. atricollis tenellus*?, *Caica hæmatotis*, *Ramphastos tocard*, and *Pteroglossus torquatus*. Several days later I was fortunate enough to find a tree in which the birds were feeding, some miles farther up the river They were attracted by the berries, with which the tree was laden. There were fifteen or more of the *Carpodectes* in the tree, besides two or three *Tityra personata*, and other species, all feeding on the berries. At each discharge of the gun the birds flew out and disappeared in the surrounding trees, from whence, in the course of fifteen minutes or so, a bird would take the initiative and return to feed, to be followed shortly by the others, who straggled in by twos and threes.

After a long wait I secured seven of the birds, also a *Tityra*, shot by mistake, and wounded two or three more *Carpodectes*, which were lost in the woods. Most of those shot were gorged with the berries. About 2 miles above the tree just mentioned I found Mr. Frederich Hansen,

who was living on a small plantation bordering the river. He was well acquainted with the birds of the region, but had never seen this species near his clearing, nor did I, during several days stay there; yet 2 miles down the river it was common. Mr. Hansen told me that he had seen this species on some of the small rivers emptying into Lake Nicaragua from the east. It was known, he said, as "Espiritu Santo," or Holy Ghost bird. September 28 I shot a female from a tall trumpet tree on the Escondido, and at the same locality on January 5, 1893, Mr. G. E. Mitchell shot ten, mostly males, which were feeding in a berry-laden tree in the plantation. Mr. Mitchell did not hear the birds utter a note, nor did any of the individuals observed by me make a noise of any description. January 19, while on board a steamer going down the river, we observed three more of the birds in a trumpet tree on the river's edge.

Length of an adult male in the flesh, 10 inches. Iris very dark brown; bill, plumbeous, with black line along the culmen; feet and legs plumbeous.

Family MOMOTIDÆ.

156. Urospatha martii (Spix).

Apparently rare. Noted on the Escondido.

157. Momotus lessoni Less.

Occasionally met with in the forest. The note is not very penetrating; it resembles "hoo-hoo," given in a rather jerky manner, and sounds far away, even when the bird is close at hand.

158. Prionirhynchus platyrhynchus (Leadb.).

Collected on the Escondido by Wickham; I did not see it.

Family ALCEDINIDÆ.

159. Ceryle torquata (Linn.).

Very common. This species has a note similar to that of *C. alcyon*, but somewhat stronger.

One morning a pair of these birds went through a very curious performance. Attention was first called to them by their loud rattling cry, which was kept up almost constantly as they circled and gyrated about over the water, occasionally dropping—not diving—into the the water, and sinking below the surface for a moment. This maneuvering lasted some minutes, after which both birds flew up stream uttering their ordinary note.

Two or three individuals were in the habit of passing the night at some point on the creek back of the "I. P." plantation, and came over just about dusk every evening. I noticed them for several months, and was struck with the regularity of their coming, and the course taken by each on its way to the roost. The birds could be heard a

considerable distance away, just before dusk, uttering their loud single "chuck" at every few beats of the wings. They appeared to come from their feeding grounds, often passing over the plantation opposite, probably to cut off a bend in the river. One of the birds invariably passed close to the corner of the laborers' quarters, though at a considerable height, and the other near a trumpet tree some distance away. The third bird was only a casual visitor. At times the birds came together, but usually there was an interval of several minutes. Their routes met at a turn of the creek a few rods back of the house, where they usually sounded their rattling notes and dropped down close to the water, which they followed to the roost. This was in a huge spreading tree, covered with parasitic plants and numerous vines, which hung in loops and festoons from the limbs. On one occasion I shot at one of the birds as it came clucking overhead, and caused it to drop several small fish. A female nearly ready to deposit eggs was shot October 9.

The birds made their appearance rather late in the morning, usually after 8 o'clock, and at times spent several hours of the day up there. Although the birds appeared to have their home at this place, I did not, on any of my numerous trips up the creek, discover the site.

According to my observations the Kingfishers on the Escondido rank about as follows in regard to abundance: *Ceryle amazona*, *C. torquata*, *C. americana septentrionalis*, *C. inda*, *C. alcyon*, and *C. superciliosa stictoptera*. The first two may be found at all times, the third is rather less common, while the last three are quite uncommon, the smallest particularly so. *C. torquata*, *C. amazona*, and *C. alcyon* have notes very much alike; the notes of the others are weak, varying in volume according to the size of the species, and are quite different from those of the large species.

On the Rio Frio, where the solitude is unbroken by river steamers, and rarely by the native dories, birds inhabiting the water's edge are abundant, and among the smaller species *Ceryle torquata* and *C. amazona* are conspicuous.

160. Ceryle amazona (Lath.).

Abundant. The note is almost the same as that of *C. alcyon*, but this bird has in addition a curious laughing note, which I have not heard from any of the other species.

161. Ceryle alcyon (Linn.).

Uncommon; observed on both rivers.

162. Ceryle americana septentrionalis Sharpe.

Rather common. Feeds largely on small crustaceans. The note is a weak "tuck."

163. Ceryle superciliosa stictoptera Ridgw.

Rarest of the Kingfishers in this region. Noted on both the Rio Frio and the Escondido.

164. Ceryle inda (Linn.).

Uncommon. The first specimen I saw was in a patch of woods, in a damp place near Greytown, some distance from any body of water, and rather an unusual place for a Kingfisher.

Family GALBULIDÆ.

165. Galbula melanogenia Scl.

Rather rare. Noted on the Escondido. Observed only on three or four occasions. It has a piercing cry, resembling "kee'-u," with the first syllable very shrill and strongly accented. The stomach of one specimen shot, contained insects. The bird jerks its tail after the fashion of a Kingfisher.

Family BUCCONIDÆ.

166. Malacoptila panamensis Lafr.

Rather rare in the forests on the Escondido. A female shot May 23, was about ready to deposit eggs. It was shot from a twig directly in front of a hole in a bamboo, in which its nest was probably located. The stomach was distended with insects, principally locusts. On July 2, another female was found, accompanied by one young bird, and both were secured.

The species seems to be confined to the thick forest, where it keeps among the lower branches, at times even descending to the bushes. Iris carmine.

September 23, I shot two birds which I supposed at the time to be mates, as they were found within 40 yards of one another, and subsequent dissection proved them to be male and female. The latter differs so much from ordinary *panamensis*, in being dark clove-brown or brownish slate above, with brownish black stripes on lateral underparts, that Mr. Ridgway applied the name *Malacoptila fuliginosa* to it in a MS. description, and in case the bird should prove to be really distinct from *panamensis*, this name may be used to designate it. For the present I prefer to include it with *M. panamensis*.

This bird, No. 127339, U. S. National Museum, Escondido River, September 23, 1892, may be described as follows:

Above deep clove-brown, rather clearer or more inclining to brownish slate on head and neck; back and tips of wing-coverts sparsely marked with minute dots of dull buffy; sides of head, beneath and behind eyes, narrowly streaked with buff; median portion of forehead, lores (except near eyes), and malar plumes white; chin and upper throat mixed white and dusky brown, the latter nearly uniform on upper throat; center of throat white, becoming light dull buff on lower throat and chest; rest of lower parts buffy white, the breast and sides conspicuously striped with dusky brown, these stripes broadest and most sharply

defined on sides of breast; under wing-coverts and broad edges to inner webs of remiges buff. Upper mandible black; lower, pale yellowish brown, tipped with black; feet horn color; iris carmine. This color from life, the others from dried skin. Wing, 3.30; tail, 2.95 lateral feather 0.80 shorter; exposed culmen, 0.95; tarsus, 0.65.

Mr. Ridgway's notes on the bird, made before knowing the circumstances under which it was shot, however, are as follows:

It is conspicuously unlike any of the twenty-three specimens of *M. panamensis* with which it has been carefully and simultaneously compared, nowithstanding the range of individual variation is so great. If *M. inornata*, as defined by Sclater and others, is separable from *M. panamensis*, then *M. fuliginosa* is certainly very distinct from both. The only other view which can possibly be justified by the series before me is that there is only one species in Central America, from Panama to Guatemala, varying individually in plumage to a remarkable degree. Should this view prove correct, then *M. fuliginosa* must be admitted to represent an extreme of coloration quite as marked as the rufescent birds which occur both at the northern and southern limits of this range.

167. Bucco dysoni Scl.

One specimen obtained in the forest on the Escondido. This individual was catching insects, and acted very much like a *Tyrannus*. On making a capture it would seek a new perch, flying in a leisurely way, and showing considerable hesitancy about selecting a place to settle upon.

Iris, wine-purple; bill, black; feet, blackish.

Family TROGONIDÆ.

168. Trogon caligatus Gould.

Apparently uncommon, on the Escondido, where all Trogons are called "Mountain Parrots" by the English-speaking people. Orbital ring yellow.

169. Trogon atricollis tenellus (Cab.).

Common. One flew into the house. Trogons are almost invariably found in pairs, rarely in small flocks. Iris very dark brown; feet plumbeous; orbital ring blue; bill chromium-green.

170. Trogon chrysomelas sp. nov.

Sp. Char.—Exactly like *T. atricollis tenellus*, except that the metallic green of the male is wholly replaced by opaque black, without the slightest trace of metallic gloss.

Adult male (Type, No. 127338, Escondido River, Nicaragua, September 23, 1892; Chas. W. Richmond): Entire head, neck, and chest uniform "dead" black; back, scapulars, and rump dull, dusky grayish brown, tinged or mixed with blackish; upper tail-coverts and middle tail-feathers brownish black, the latter abruptly tipped with deep black (about 0.40 of an inch wide). Wing-coverts and outer surface of closed

secondaries very finely vermiculated with black and white; rest of wing black, the primaries edged with white, this occupying whole outer web at the base. Three outer tail-feathers mostly white (the outermost wholly white for the exposed portion), broadly tipped (for about 0.45 of an inch on first to 0.70 of an inch on the third feather) with white, the remaining portion sharply and regularly barred on both webs with black, the black bars averaging very nearly as wide as the white interspaces. Under parts, posterior to the chest, wholly rich cadmium yellow, becoming a little paler next the black of the chest. Bill greenish horn color, with tomia and culmen yellowish; feet horn color. Length (skin), 9.25; wing, 4.30; tail, 5.40, the outermost feather 2.35 shorter; culmen, 0.75.

Following is a description of the supposed female of this species:

Adult female (Type, No. 128377, Escondido River, Nicaragua, January 17, 1893, Chas. W. Richmond): Upper parts, including upper tail coverts, sides of neck, malar region and auriculars, slate-black, almost pure black on pileum; middle pair of tail feathers slate-black, with a terminal black bar of 0.20 inch. Wings black, primaries, second to sixth, with outer webs edged with white; secondaries and wing-coverts narrowly barred with white, bars 0.10 inch apart. A white spot before and one behind the eye; throat and breast between mouse- and smoke-gray, a narrow band of white posteriorly and bordering the yellow of the lower breast. Lower breast, abdomen, and under tail-coverts deep cadmium-yellow; sides olive-gray; feathers of tarsus black, whitish at the base. Second pair of rectrices black, somewhat lighter on the outer web; third pair black; three outer pairs tipped with white, broad on the outer web, but narrowing down to a mere edging on the inner web at the tips of the feathers; the outer feather barred for its exposed length, but basal half of this barring more in the nature of spots, which do not touch the shaft, and become smaller toward the base; the second feather is similar but has less barring; the third still less. Exposed culmen, 0.66; width of bill at base, 0.69; wing, 4.70; longest tail feather, 5.10; shortest, 3.28; tarsus, 0.58. Orbital ring clove-brown; iris dark brown.

The female just described resembles that of *T. caligatus* almost exactly, but the barring on the wing coverts and secondaries is very different, and there is a slight difference on the upper parts, a perceptible gloss being present on these parts in the bird just described.

171. Trogon massena Gould.

Common. These birds feed largely on berries and fruit. The birds while picking at the fruit sometimes hang from the end of a branch, back downward, with wings fluttering, at such times presenting a very striking appearance.

Iris dark yellow; mandible orange.

172. Trogon melanocephalus Gould.

Common. The most abundant of the Trogons in the localities visited by me. It often wanders into the plantations. Sometimes found in companies of six or eight. The note is of one syllable, often repeated.

The flight of this and other species of Trogons is very irregular, something like that of a Goldfinch (*Spinus tristis*).

Orbital ring pale blue; iris dark brown.

Family CAPRIMULGIDÆ.

173. Chordeiles virginianus henryi (Cass.).

Exceedingly abundant during fall and winter on the Escondido. First seen August 17. Specimens from Arizona, Mexico, and Nicaragua as a general thing have shorter wings than birds from the north, the difference being about a half inch, but in one Nicaraguan specimen the wing is fully as long as in northern examples, while three specimens from the Dakotas and Minnesota are as small as any of the southern ones.

174. Nyctidromus albicollis (Gmel.).

Abundant, particularly at Greytown. These birds are very partial to open places and clearings, but are also found, though less commonly, in the dense woods. Specimens shot at Greytown early in February were breeding, and eggs about to hatch were obtained May 18. During the mating season two or three of these birds get together and utter very remarkable, low, guttural noises impossible to describe. The ordinary note may be represented by "kwe-ah-réo," uttered in a clear, ringing, and rather tremulous voice, and can be heard a long distance; the call from a distant bird sounds like "ah-réo." The birds are so abundant that at night the air seems to be filled with their notes, coming from all directions.

Stenopsis albicauda Lawr? While paddling up the Rio Frio, birds were several times observed that I now feel quite sure were of this or another species of *Stenopsis*. They made their appearance just before nightfall, while still enough daylight remained to allow a fair sight of them. They flew close to the edge of the forest, at a height of 30 or more feet above the water. Their flight was steady and rather slow. The birds appeared to be grayish and had square tails. I did not hear any note. In April, about 10 miles from Greytown, I saw one as it flew across an opening in the forest and disappeared in the dark trees beyond. If not *Stenopsis* these birds were of a species as yet not recorded from Nicaragua or Costa Rica.

Family MICROPODIDÆ.

175. Panyptila cayanensis (Gmel.).

Common at the "I. P." plantation on the Escondido, but not observed elsewhere. Specimens are very difficult to obtain on account of the

high-flying habit of the birds. It is almost impossible to obtain any of the Swifts except during the rainy season, as at other times they fly high, far out of gun range. This appears to be the only record for the species north of Panama. For a note on the nest of this bird see *The Auk*, x, January, 1893, 84.

176. Chætura gaumeri Lawr.

Common on the Escondido. Specimens of this and the following species taken about the last of May were apparently breeding. The reference to *Chaetura vauxi* on the Escondido, in the Biologia, Aves, II, 376, belongs to this species, as I did not find *vauxi*.

177. Chætura cinereiventris guianensis Hartert.

Two specimens shot on the Rio Frio, from a large company of Swifts, and others were collected on the Escondido, at "I. P." plantation, where, with *C. gaumeri*, it appeared to be common.

On the Rio Frio I saw numbers of a larger, black Swift, about the size of *C. bruneitorques*, but was unable to get specimens.

Family TROCHILIDÆ.

178. Glaucis hirsuta (Gmel.).

Common in the forest, where it keeps near the ground, as do the two following species. Feet flesh-colored.

179. Threnetes ruckeri (Bourc.).

Much less common than the above; its habits are the same. It was noted on the Escondido. Feet flesh-colored.

180. Phaëthornis longirostris (Less. and Delattre).

Common in the forest on the Escondido, and not infrequently seen in the banana plantations, near the woods. It is quite partial to the flowers of the "Wild plantain" (*Heliconia*). This and the other forest or Hermit Hummers are often found along streams, which they follow through the woods, pausing an instant here and there to investigate a spider's web or bright-colored flower, of which there are many in these places. When darting rapidly through the woods, it utters a sharp, shrill "chweep" at short intervals, and it is not a little startling to have one of these birds shriek as it shoots by within a few inches of one's head. Feet flesh-colored.

181. Pygmornis adolphi (Bourc.).

Common on the Escondido. It is confined to the forest. I did not hear it utter any note. One is made aware of its presence by the noise produced by its wings, a faint buzz not louder than that made by a humble bee.

The crimson blossoms of a small spreading tree, common in the woods, are quite attractive to this species.

Basal half of mandible Naples yellow; feet flesh-colored.

182. Lampornis prevosti (Less.).

Taken at Los Sábalos and San Carlos. It was rather common at the latter place in trees which bore trumpet-shaped carmine flowers.

183. Florisuga mellivora (Linn.).

A pair obtained in a cacao plantation on the San Juan, near Greytown. It was rather common there.

184. Amazilia fuscicaudata (Fras.).

Very abundant at all places visited, far outnumbering the other Hummingbirds. This species is confined to clearings, and does not occur in the forest. On the Escondido it haunts the banana plantations, where it is attracted by the large purple flowers of the banana plants. The note is almost identical with the "tuck" of the Junco (*Junco hyemalis*).

Bill brownish carmine, except tip, which is black.

185. Polyerata amabilis (Gould).

Rather uncommon. Observed on both rivers. It is usually found in clearings and plantations, but occasionally in open woods. I once shot a specimen as it hovered before some flowers, on the opposite side of a small creek. It fell into the water, and almost immediately a green lizard ran to it, brought it out, and, after shaking it, deposited it on the moss, with which the ground was covered. The lizard then assumed a ludicrous position and contemplated the victim, which was still alive, and would probably have devoured it had I not shot it also, thus securing two specimens instead of one. Mr. Mitchell one day had his attention called to an Iguana in a tree near the house by the cries of a small bird, which the reptile had caught. The large lizards and Iguanas probably catch small birds for food whenever the opportunity offers.

Family CUCULIDÆ.

186. Crotophaga sulcirostris Sw.

Abundant in plantations and clearings. Seems to be gregarious all the year round. The stomachs of many of those I examined contained grasshoppers, with which they often gorge themselves.

187. Piaya cayana mehleri (Bonap.).

Common. This species has a habit of running along the limbs, which gives it a close resemblance to a squirrel. It is indifferent as to choice of surroundings, being found in trees in clearings or in the forest, sometimes only a few feet from the ground, and again in the high trees.

188. Coccyzus minor (Gmel.).

One specimen secured at Greytown.

A Cuckoo noticed on the Escondido was either *C. americanus* or *C. erythrophthalmus*.

Family RAMPHASTIDÆ.

189. Ramphastos tocard Vieill.

Common. This and the following species are seldom seen during the summer months, but from October or November on through the winter they are seen daily, sometimes in large flocks, and often come out into the plantations. Both of these species make a curious croaking noise, while assembled in some solitary tree or retired place, but if disturbed they fly silently away. It is the only note I have heard them utter.

190. Ramphastos brevicarinatus Gould.

This species is more abundant than the above. Its habits are the same. I shot a young one which had been feeding on the ground, judging from the mud on the feet and bill.

191. Pteroglossus torquatus (Gmel.).

Very common. Frequently found in small companies of from five to eight. Several may sometimes be killed out of a flock before the remaining ones make up their minds to fly away. The note resembles "palíce," which is the pronunciation of the Spanish word *feliz*, meaning happy. It is uttered in a shrill, squeaky tone, and the natives call the bird by this name, but I have heard it applied to neither of the other Toucans here.

When a flock of the birds are disturbed they call excitedly, and emphasize their displeasure by rapping their bills against their perch.

Iris lemon-yellow; orbital space, poppy-red, becoming brownish black immediately around eyes; feet and legs sage-green.

Family PICIDÆ.

192. Campephilus guatemalensis (Hartl.).

Common. Although a forest bird, it often occurs in the clearings. Iris yellow.

193. Ceophlœus scapularis (Vigors).

Not as common as the above species. Iris almost white.

194. Celeus castaneus (Wagl.).

One individual obtained on the San Juan, near Greytown.

195. Chloronerpes yucatanensis (Cabot).

One obtained at San Carlos February 25. It was a female, and would shortly have deposited eggs.

196. Eleopicus* caboti (Malh.).

Common in the woods on the Escondido. Often found near the colonies of traveling ants.

197. Melanerpes pucherani (Malh.).

The most abundant Woodpecker in the region. Found in open places in the woods, and in clearings.

198. Picumnus olivaceus Lafr.

One adult male was taken at San Carlos February 26. Judging from its actions and the high development of the testes, it had a nest somewhere in the vicinity. This bird appears to be true *olivaceus;* it does not agree with Mr. Ridgway's *flavotinctus*. Feet plumbeous.

Family PSITTACIDÆ.

199. Ara macao (Linn.).

Very common. Generally in pairs or companies of pairs. A tree cut down late in February contained two eggs of this species. Naked skin on head flesh-color.

200. Ara militaris (Linn.).

Somewhat less common than the above. Habits and notes similar. Naked skin on head pale carmine-purple; iris dark yellow, but varies in different individuals.

201. Brotogeris jugularis (Müll.).

Observed at San Carlos, on the lake, if my memory serves me right, but I do not find any reference to the species among my notes.

202. Conurus finschi Salv.

Common on the Escondido. Feeds usually in the large trees standing in the plantations, but at times in small trees bordering the forest, where one day I found a flock of about twenty-five scattered about in low trees that were laden with berries. The birds were tame and allowed me to approach them very closely.

203. Conurus aztec Souancé.

Abundant. Often seen in large flocks.

204. Amazona salvini (Salvad.).

Common. Collected at Greytown and on the Escondido. Iris orange.

205. Pionus senilis (Spix).

Very common on the Escondido. Iris orange.

*The name *Dendrobates*, Sw., usually employed for this genus, is preoccupied (Wagler, 1830; *Batrachia*).

206. Pionopsitta hæmatotis (Scl. and Salv.).

Observed on the Rio Frio, where a flock of about a dozen were found in a fruit tree. The birds were perfectly quiet and made no noise, even after I had shot into the tree several times and wounded some.

Family STRIGIDÆ.

207. Strix pratincola guatemalæ Ridgw.

One specimen obtained on the Escondido.

Family BUBONIDÆ.

208. Syrnium virgatum Cass.

One specimen was brought to me alive on the Escondido. Iris mummy-brown.

209. Syrnium perspicillatum (Lath.).

Collected by Wickham on the Escondido.

Family FALCONIDÆ.

210. Pandion haliaëtus carolinensis (Gmel.).

Common during the winter months, particularly near the coast. Observed as late as May.

211. Falco albigularis Daud.

Common on the Escondido. This bird flies very rapidly, and is quite noisy. Its note slightly resembles that of the Sparrow Hawk (*F. sparverius*), and also that of the Killdeer (*Ægialitis vocifera*). Food consists largely of grasshoppers. One evening just after sundown I saw one of these birds pursue and catch a large moth that was flitting above the tree tops.

This Hawk appears to be confined to the plantations and clearings, where it prefers a perch on some prominent dead limb, from which it makes frequent forays.

On cloudy afternoons or just about dusk the birds often fly up and down over the river until they can hardly be distinguished in the growing darkness.

Iris dark brown; cere and naked space around eyes yellow; feet and legs pale orange.

212. Falco sparverius Linn.

Very common in winter. First seen October 16, and one shot late in February.

213. Micrastur guerilla Cass.

One specimen shot on the Escondido, in a thicket bordering the forest.

214. Herpetotheres cachinnans (Linn.).

Common on the Escondido. The guttural laugh which usually precedes the long call of this species can be heard only a short distance. The birds call most frequently about dusk, and keep it up until after dark. The first individual I saw was in a large dead tree on the Rio Frio, near where I was encamped for the night. It began its monotonous call about dark and continued it for fully fifteen minutes. It is often called "Rain Crow" by the Americans on the Escondido.

Iris burnt umber.

215. Elanoides forficatus (Linn.).

A small company noticed circling about on the Escondido on May 15.

216. Circus hudsonius (Linn.).

Common during the winter on the Escondido. I shot one October 2, in the act of carrying off a chicken. In Nicaragua it never lets an opportunity pass to get a chicken, probably because it fails to secure enough food in other ways, as the conditions are totally different from those prevailing in its hunting grounds in the United States. Small mammals appear to enter very little into the food of the birds of prey there, owing to the dense vegetation and the difficulty of securing them, but lizards, snakes, and insects are much sought for.

217. Accipiter velox (Wils.).

Found by Wickham on the Escondido; I did not meet with it.

218. Urubitinga anthracina (Licht.).

219. Urubitinga urubitinga ridgwayi (Gurney).

Not very common. Found usually in pairs. The above two species were observed on the Escondido, where Wickham secured specimens. Also noted at San Carlos.

220. Leucopternis ghiesbreghti (DuBus).

Mr. G. E. Mitchell got one specimen in the forest on the Escondido.

A Hawk that may be *Leucopternis plumbeus* Salv. was often noticed on the Rio Frio. It was usually found perched on limbs over the water, and was very tame, allowing the dory to pass under it at a distance of less than 10 feet, in some cases. One was observed to catch a large green lizard. Unfortunately no specimens were preserved, and the identification must remain in doubt.

221. Rupornis ruficauda (Scl. and Salv.).

This is the most abundant Hawk on the Escondido. It is found in the plantations and cleared places, usually in pairs.

Iris noted as yellow, and in some specimens as light brown, the latter probably immature birds; cere yellow.

222. Buteo latissimus (Wils.).

Rather common on the Escondido during the winter months. First seen September 30.

223. Buteo brachyurus Vieill.

One specimen secured on the Escondido.

224. Busarellus nigricollis (Lath.).

Observed at Greytown on several occasions.

Family CATHARTIDÆ.

225. Gypagus papa (Linn.).

Frequently observed on the Escondido, and occasionally several were seen in one day, but the birds habitually pass the time so high in the air that they will ordinarily escape notice. One secured on the Rio Frio. It was attracted to the clearing by a large snake killed a few days previous. As the bird came sailing overhead several Black Vultures out of respect vacated the tree in which it was about to light.

It would be quite useless to attempt a description of the colors of the naked skin of the head and neck of this bird without a diagram.

Iris white.

226. Catharista atrata (Bartr.).

Very common. One afternoon while paddling up the creek I heard a remarkable hissing noise, as of some body going rapidly through the air, and looking in the direction of the sound, saw a dark object shoot through the air in a downward direction and disappear behind some trees, but the movement was so swift that I could not identify it, even as a bird. Shortly afterward another object came down with the same rapidity and noise, but I could not place it. About a month later I was in a cattle pasture containing solitary dead trees here and there, with a few Black Vultures perched about, when I heard this same noise and saw a bird dive down and make a sharp turn when near the tree tops to check its speed, then sail up and perch with the other birds on the trees. This operation was repeated by several other birds, all of this species, which were very high in the air, and it was no doubt the means taken by them to reach the earth quickly. The birds observed on the first occasion were also doubtless of this species.

227. Cathartes aura (Linn.).

Common, but less abundant than the above.

Family COLUMBIDÆ.

228. Columba nigrirostris Scl.

This is the common mourning Pigeon of the region. Abundant, particularly along streams, where its favorite perch is in the trumpet tree. It is confined mostly to the forest.

Iris vinaceous; bill black; feet pink.

229. Columba speciosa Gmel.

Two specimens secured on the Escondido. Mr. G. E. Mitchell shot a young bird in first plumage October 26.

Colors of adult: iris, brown; feet, lavender; bill, vermilion.

230. Columba rufina (Temm.).

One specimen taken on the Escondido.

231. Engyptila cassini (Lawr.).

Several secured on the Escondido.

232. Engyptila vinaceiventris Ridgw.

Specimens supposed to be this species were taken on the Escondido, and others seen. My identification rests on the description (Proc. U. S. N. M., x, 1887, 583), the type not being available at this time.

The bird occurs in clearings. Iris light yellow.

233. Peristera cinerea (Temm.).

Quite common on the Escondido, where it appears to be resident only part of the year. First noted about September 20, when its peculiar two-syllabled call was frequently heard.

Found in bamboos along streams, or in solitary trees in the plantations, usually in pairs.

234. Columbigallina passerina pallescens (Baird).

One shot at San Carlos.

Family CRACIDÆ.

235. Penelope cristata (Linn.).

Common in the forests on the Escondido, where it is found usually in the loftiest trees, as is *Crax globicera*. These birds are much hunted by the natives, who call them "Qualms." A hunter is guided almost entirely by the low, prolonged cry of the birds, uttered at times while feeding, as without this clew it is almost impossible to find them.

Iris carmine; naked skin of throat dull carmine; scuttelæ of tarsus and feet coral red.

236. Ortalis cinereiceps (Gray).

Common. Known as "Chachalaca" by the Spaniards, and often called "Wild Chicken" by the Americans on the Escondido. It is frequently seen on the borders of banana plantations and in open places in the forest, usually in small flocks.

These birds are heard most frequently about dusk, chanting their monotonous notes, which resemble their Spanish name.

On one occasion I fired into a tree over a dozen times while a small flock of these birds were feeding in it. They remained throughout the disturbance, clucking to one another occasionally, as if uncertain as to the propriety of remaining. At other times I have noticed them exhibit undue haste in retreating from view, but ordinarily they are moderately tame.

237. Crax globicera Linn.

Rather common. Observed on the Rio Frio and on the Escondido. It is often kept in captivity. A fine male on the Magnolia plantation was very tame, and answered to the name of "Touie." One of Touie's peculiarities was an abhorence of women. The moment a dress appeared on the plantation he began to show great distress, uttering his low, plaintive whistle, and running after the object of his wrath, with body leaning forward and almost brushing the ground, head thrown back, and tail raised, giving him a laughable appearance. After picking at the offending dress and following its wearer about for a time, Touie would quiet down a bit, but would continue to sulk and utter his note of complaint until the cause of the trouble had departed. This bird raised its crest when excited, or when its curiosity was aroused, but on other occasions kept it depressed.

Iris dark brown; cere Naples yellow.

Family PERDICIDÆ.

238. Odontophorus melanotis Salv.

A flock of over a dozen was observed in the forest on the Escondido. When approached the birds flew into the surrounding trees and afterwards off into the woods, two or three at a time. Two were secured.

239. Odontophorus spodiostethus Salv.

One specimen. It was one of a pair found running in a path in the woods on the Escondido. Following is a description of this bird, which has been compared with a specimen from Panama, belonging to the American Museum of Natural History:

Pileum and cervix sepia, edged with mummy brown, some of the feathers with slender shaft-streaks of buff; a line of feathers on sides of head bordering superciliary stripe tipped with fine, tear-shaped buff spots, edged with blackish, these feathers most numerous and markings largest just above, and posterior to, black auricular marks; interscapular region, including sides of neck, dark gray, broadly edged or bordered with light chestnut; this is followed posteriorly and on the scapulars by light olive-brown, the feathers for the most part faintly and almost imperceptibly vermiculated with a darker shade, having slender buff shaft-streaks, and usually the inner web black, with deep chestnut mottlings. Back, rump, and upper-tail coverts light olive, an occasional feather with a narrow black shaft-streak; the feathers minutely

and indistinctly barred with wavy lines and specks of blackish; tail similar, but with a faint chestnut tinge. Wings dull blackish brown; the primaries, except the first, with faint, nearly obsolete barrings on the outer web; exposed portion of secondaries irregularly spotted or marked with buff; wing-coverts light grayish olive, irregularly and finely mottled and spotted with buff and dull black, some of the feathers dull black on the inner web, with brownish edgings. Breast and jugulum dark gray, feathers faintly tipped with burnt-umber, just enough to give the gray color a soiled appearance; throat dusky grayish white, passing gradually into the gray of the jugulum; chin, malar region, auriculars, lores, anterior part of forehead, and broad superciliary stripe tawny; a dusky streak before eyes; upper part of auriculars brownish black. Lower breast, sides, and encroaching to some extent on abdomen, buffy ochraceous; rest of sides light olive-brown; abdomen creamy buff, changing to almost white posteriorly; flanks and under tail coverts buff, rather conspicuously but unevenly barred with black.

The American Museum specimen has more tawny on the head, the whole pileum being tinged with it; the buffy ochraceous is more extensive on the sides; the flanks and under tail-coverts are not nearly so conspicuously barred, and the back, rump, upper tail-coverts, and tail are strongly tinged with brownish buff.

The following measurements may be useful:

Number.	Collection.	Locality.	Exposed culmen.	Wing.	Tarsus.	Tail.
128406	U. S. N. M.	Escondido River, Nicaragua	.60	4.51	1.30	1.88
45162	American Museum.	Panama	.60	4.47	1.36	1.83

The length of wing, given in Mr. Salvin's original description is 4.20 inches. The American Museum specimen, formerly in Mr. Lawrence's collection, is labeled "*Odontophorus rubigenis* Lawr.," but I am not aware that any description was ever published. The specimen was collected a year or so after the description of *O. spodiostethus* appeared.

Family TINAMIDÆ.

240. **Tinamus robustus** Scl.

Rather common in the forest on the Escondido. Those shot were extremely fat, and the flesh very tender, white, with a greenish tinge. These birds are known as "Mountain Hens," and probably one of the species of Tinamou is the one called "Six o'clock Bird," which has a very melancholy call of three syllables, uttered about sundown, and also occasionally during the day.

241. **Crypturus pileatus** (Bodd.).

Common in the forest on the Escondido. Iris light brown.

242. Crypturus, sp.?

A bird of this genus, shot on the Escondido, was partly eaten by a cat before I could save it. The wings, back, and some other portions of the plumage were preserved, and later compared with the various species in the National Museum series, but agreed with none of them. In length of wing it matches *C. boucardi* and *C. sallæi*, and in regard to plumage comes nearer the former, but appears to be distinct from both. Legs and feet orange-vermilion.

Family CHARADRIIDÆ.

243. Ægialitis vocifera (Linn.).

Common; first heard November 11.

244. Ægialitis collaris (Vieill.).

One shot February 29 on the Rio Frio.

Family SCOLOPACIDÆ.

245. Gallinago delicata (Ord).

Common at San Carlos in February, and exceedingly abundant at Magnolia Plantation on the Escondido, during my stay there in November and December. First observed October 16.

246. Totanus flavipes (Gmel.).

One seen on the Escondido October 16.

247. Totanus solitarius (Wils.).

Rather common. First noticed September 30.

248. Actitis macularia (Linn.).

Common. Observed from July 30 to May 16.

249. Bartramia longicauda (Bechst.).

One seen November 26 on the Escondido.

250. Tringa minutilla Vieill.

Two shot on the Rio Frio February 29, and another shot on the Escondido in December. This latter had been noticed associating with a flock of Killdeers some time previous to its death.

Family RECURVIROSTRIDÆ.

251. Himantopus mexicanus (Müll.).

A small flock observed on the Rio Frio February 29.

Family CICONIIDÆ.

252. Mycteria americana Linn.

Noticed on the Rio Frio, and at Magnolia Plantation on the Escondido. Mr. Bowman, a plume hunter, informed me that he occasionally saw it on the lake, where it was known as "Beterano."

253. Tantalus loculator Linn.

Common on the Rio Frio, and on the Escondido. On the latter river the birds were quite abundant in a marsh back of Magnolia Plantation.

Family PLATALEIDÆ.

254. Ajaja ajaja (Linn.).

A flock of seven noticed on the Rio Frio.

Family COCHLEARIIDÆ.

255. Cochlearia zeledoni Ridgw.

Common on the Rio Frio, where several colonies were noticed. Two specimens obtained on the Escondido. The note of this species is a squawk, something like that of the Night Heron, and like the latter bird this species is nocturnal.

Eyes black and very large; feet and legs pale green.

Family ARDEIDÆ.

256. Ardea tricolor ruficollis (Gosse).

Two specimens noted on the Escondido.

257. Ardea candidissima Gmel.

Rather common on the Rio Frio; not often noticed on the Escondido.

258. Ardea egretta Gmel.

Abundant on Lake Nicaragua, where it breeds in large colonies on the islands. Common on all the rivers and lagoons.

The plume hunter is at work on the lake, engaged in exterminating these birds. Two men are established at San Carlos, and have been engaged in this business for three or four years. They sell their plumes to a New York dealer. A firm in Greytown offers 50 cents for each bird of this species brought in, and this probably explains the scarcity of the birds about Greytown.

259. Ardea herodias Linn.

Common.

260. Ardea virescens Linn.

Apparently a winter resident only, at which season it is very common. First noticed early in October.

261. Ardea cœrulea Linn.

Abundant. Barring *A. egretta*, it is the most abundant of the Herons. Individuals in the white plumage largely predominate.

262. Tigrisoma excellens Ridgw.

One specimen shot on the Escondido, and others supposed to belong to this species, heard on the same river. The bird is nocturnal, and

has a very distressing note, like the groan of some one in agony. A *Tigrisoma* was common on the Rio Frio, but no specimens were obtained.

263. Tigrisoma cabanisi Heine.

Given in the list of birds obtained by Wickham on the Escondido.

264. Nycticorax nycticorax nævius (Bodd.).

Common, especially on the Rio Frio.

Family ARAMIDÆ.

265. Aramus giganteus (Bonap.).

Several noticed on the Rio Frio.

Family RALLIDÆ.

266. Aramides plumbeicollis Zeledon.

One pair observed on the Escondido. They were in the woods on the bank of a stream, and were cackling very much like a Guinea fowl. I shot one of them, at which the other set up a loud scolding. My bird agrees with the original specimens of *A. plumbeicollis* obtained at Jiménez, Costa Rica, by Sr. Alfaro, who informs me that he has found the *A. cayennensis* only on the Pacific side of Costa Rica. In looking over the *Aramides* in the National Museum, I find one specimen of *cayennensis* labeled "Talamanca" (Gabb), but with this exception all others from the east side are *plumbeicollis*. An immature bird from Honduras (Segovia River) is also referable to this species. Two from David, Chiriqui, are *cayennensis*.

267. Fulica americana Gmel.

Several seen on the Escondido.

268. Porzana cinereiceps Lawr.

Abundant at all places visited. It is especially numerous in the tall grass that lines the river banks. The bird is quite fearless, and is easily called out of hiding by imitating the squeak of a young bird, or by making any unusual noise. It breeds commonly in the plantations on the Escondido, where it builds its nest in the grass, generally about a foot from the ground. The nest is made of dried grass, lined with a broad-leaved grass. It is almost globular in shape, and has a small entrance in the side. It is very difficult to find the bird on the nest, as it leaves on the slightest suspicion of danger, and skulks off through the grass uttering a sharp "chip."

The call is a curious, harsh, grating chatter. These birds were frequently caught in traps set for small mammals along the river's edge.

The eggs are from three to five, short ovate, pale creamy white, spotted, principally at the large end and sparingly over the rest of the surface, with cinnamon-rufous, mixed with lavender. Measurements of three sets are as follows: 1.11 by 0.85, 1.10 by 0.83, 1.08 by 0.85, 1.07 by 0.85; 1.12 by 0.84, 1.10 by 0.82, 1.13 by 0.82, 1.07 by 0.83, 1.08 by 0.81; 1.10 by 0.82, 1.07 by 0.82, 1.10 by 0.83. Nests were found from early in May until late in August.

In a series of seventeen adults, including the type of the species and also that of *P. leucogastra* Ridgw., I find a wide range of variation, especially in the amount of white on the underparts. In individuals recently adult, the white extends from the throat to the under tail-coverts, including the tibia. In some specimens this is uninterrupted, but in most of them there is a narrow pectoral band of cinnamon, with faint white edges to the feathers when the plumage is fresh. In these young adults the gray on the forehead and sides of head is often entirely absent, or very dull and much restricted. The specimens before me show these variations in all stages. In some of the apparently old adults the gray of the head is very restricted, and in one example its place is taken by umber brown. The black and white bars of the lower sides, flanks, and under tail-coverts varies much. In some the white bars are very narrow and in others quite broad. The black is intense in some individuals and dull in others. The variation in size is also considerable, as an examination of the accompanying table of measurements will show. The smallest specimen in the series is a female from the Rio Frio. This bird, in addition to its small size, has the shoulders and some of the wing-coverts very distinctly barred with white; the feathers thus barred are much darker than in ordinary birds, in fact almost black. A bird from the Escondido also has these barred shoulders, and one other shows a faint approach to it. In the type of *P. leucogastra* some of the feathers of the under tail-coverts are tinged with light rufus, an approach to which is noticed in other specimens of the series. I am unable to separate *P. leucogastra* from *P. cinereiceps*.

Number.	Collection.	Locality.	Sex.	Culmen.	Wing.	Tarsus.
67904	U. S. N. M	Type, Costa Rica (Gabb.)	♀	0.63	2.90	1.12
126286	....do	Greytown, Nicaragua	♂	.70	2.82	1.10
126334	....do	Rio Frio, Costa Rica	♀	.63	2.67	1.02
127050	....do	Escondido River, Nicaragua	♂	.73	2.90	1.26
128387	....do	......do	♂	.71	2.85	1.21
128388	....do	......do	♂	.71	2.83	1.17
4042	C. W. R	......do	♀	.70	2.80	1.11
4049	....do	......do	♀	.70	2.87	1.16
4084	....do	......do	♂	.71	2.95	1.19
4085	....do	......do	♀	.66	2.84	1.15
128390	U. S. N. M	......do	♂	.65	2.75	1.10
4250	C. W. R	......do	♀	.64	2.92	1.15
4319	....do	......do	♂	.70	2.95	1.19
128391	U. S. N. M	......do	♀	.65	....	1.11
4321	C. W. R	......do	♂	.70	....	1.15
128389	U. S. N. M	......do	♂	.75	2.83	1.19
91302	....do	Type of P. leucogastra Ridgw., Los Sábalos, Nicaragua.	♂	.70	2.75	1.20

The downy young are entirely black above, slightly glossy; underparts dull black, deepest on chest and sides; throat dull light gray, mixed with black down; abdomen and flanks dark smoke gray, with a tinge of buff on the former; a sooty grayish streak along the median line.

Immature birds are clove brown above, becoming dull black on the tertials, rump, and tail. Top of head dull dark grayish, the feathers indistinctly edged with dark brown; sides of neck, and nape, with faint tinge of rufus; sides of head, neck, and breast smoke gray, obscurely tipped with dusky; throat, and underparts medially, dull white, the latter more or less tipped with dusky; lower sides and flanks dark grayish, obscurely barred with dull white. Wings sepia brown. In birds slightly older than this there is a buffy suffusion on the abdomen and under tail-coverts, and isolated cinnamon feathers appear on the breast.

Iris of the adult, carmine; feet and legs, olive; bill apple green at base; in immature birds the iris is dark brown; mandible plumbeous.

269. **Porzana exilis vagans** Ridgw.

One specimen taken on the Escondido. It was caught while running through the grass by one of the laborers.

This specimen agrees very minutely with the type in most points, but has rather less barring on the wing coverts and the tarsus is much shorter. Measurements are as follows:

Number.	Locality.	Sex.	Culmen.	Wing.	Tarsus
112255	Type: Segovia River, Honduras	♂	0.66	2.82	1.05
127053	Escondido River, Nicaragua	♂	.63	2.82	.86

Eyelids clay color; feet raw umber; iris carmine, bill as in the above species.

Family JACANIDÆ.

270. **Jacana spinosa** (Linn.).

Very common at Greytown, and at Magnolia plantation on the Escondido. Young birds about a week old were noticed April 10. Birds in immature plumage seem to predominate at all seasons of the year.

Family HELIORNITHIDÆ.

271. **Heliornis fulica** (Bodd.).

Common on the Rio Frio, but much less so on the San Juan and Es condido, no doubt on account of the traffic on the latter rivers. The birds are usually found close to the patches of tall grass that occur at intervals along the banks of the streams. They are almost invariably in pairs, rather shy, and quick to seek shelter if approached. A favor-

its hiding place is under the fringes of bushes and trees which hang over the water in many places. When disturbed they swim at once for cover, to reach which they are sometimes obliged to cross the river, and will fly if hard pressed or if the distance is considerable. After a hiding place is reached they fly into the bushes overhead or swim uneasily about until forced to take to another place. A bird will often sink below the surface leaving only the head exposed, but as it always faces the object in pursuit its white breast is readily seen, even under water. When suddenly surprised, as for instance at a bend of the river, the bird dives quickly and is not seen again. It also dives when wounded, but only when escape by flight or swimming is impossible. My observations are to the effect that it dives only as a last resort.

Family ANATIDÆ.

272. **Dendrocygna autumnalis** (Linn.).

On an overflowed piece of land on the Rio Frio I saw a flock of over two thousand birds of this species. Small flocks of a dozen are often seen on the Escondido. Known as "Whistling Duck" from its note. It is commonly kept in captivity.

273. **Cairina moschata** (Linn.).

Rather uncommon and extremely shy. Frequently seen in the domestic state. Noted singly or in pairs.

274. **Anas discors** Linn.

Three individuals, one of which was shot, observed swimming in the Escondido, December 27.

275. **Dafila acuta** (Linn.).

One specimen shot and a few others seen on the Escondido in December.

Family PELECANIDÆ.

276. **Pelecanus fuscus** Linn.

Common near Greytown and Bluefields on the lagoons.

Family SULIDÆ.

277. **Sula piscator** (Linn.).

The evening before we reached Greytown, from Kingston, a pair of Boobys flew around the ship as if intending to spend the night on board, and, after considerable reconnoitering, one of the birds perched on the rigging at the bow of the boat, where it was caught by W. L. Richmond.

278. Sula leucogaster (Bodd.).

Very abundant along the coast, nesting on the various keys which there abound. No specimens were secured, but the identification is supposed to be correct.

Family FREGATIDÆ.

279. Fregata aquila (Linn.).

Very common along the coast, and not rare on Lake Nicaragua. Occasionally seen on the Escondido, at a distance of 50 miles from its mouth. The birds breed abundantly on the keys off the coast.

Family PHALACROCORACIDÆ.

280. Phalacrocorax sp.?

A Cormorant was abundant on the lake, and numbers were seen on the Rio Frio. Rarely noted on the Escondido.

On the lake I one day saw over a thousand, fishing. They nest on the islands of the lake, where, Mr. Bowman told me, he had found as high as five thousand in one breeding place. Such a place was visited by him during my stay at San Carlos in February, and he reported finding eggs and young in all stages at the breeding grounds.

Family ANHINGIDÆ.

281. Anhinga anhinga (Linn.).

Abundant on the Rio Frio, and often seen on the Escondido.

Family LARIDÆ.

Terns of several species were seen at Greytown and Bluefields, but no specimens were secured.

DESCRIPTION OF A NEW SPECIES OF FRUIT BAT, PTEROPUS ALDABRENSIS, FROM ALDABRA ISLAND.

BY

FREDERICK W. TRUE,

Curator of the Department of Mammals.

Among the mammals recently collected by Dr. W. L. Abbott, in the islands north of Madagascar, are two specimens of an interesting species of *Pteropus*, apparently undescribed, from Aldabra Island. This species is peculiar in having the orbits completely encircled by bone, and the color of the back and hairy parts of the extremities light yellow-gray.

The two specimens here described are both males. One was collected September 26, 1892, and the other October 5, 1892.

Pteropus aldabrensis, sp. nov.

Ears long, acute, nearly naked. Fur dense and soft; that of the under surfaces and rump wavy. Fur of the back about 20mm. long, nearly straight, directed backward and appressed. Interfemoral membrane very narrow in the center and concealed by the fur. The fur extends on the upper sides of the tibia nearly to the tarsus, and there are a few hairs on the tarsus and metatarsus and at the base of the claws. On the under side the fur is confined to the proximal half (or less) of the tibia. Upper sides of humerus and proximal half of the forearm clothed with appressed fur; a naked area on the elbow. On the under side of the humerus the fur extends thickly almost to the elbow. The under surface of the præbrachium is clothed nearly to the line of the middle of the forearm. On the endopatagium a band of hair, having the width of the præbrachium, extends from the sides of the body to the elbow, and is continued (growing gradually narrower) to the carpus. The interfemoral membrane is clothed above and below about to a line joining the centers of the tibiæ. The posterior margin of the endopatagium is sparsely clothed with hairs.

Muzzle, lower jaw, and throat dusky brown. Head and cheeks pale yellow. Nape, shoulders, sides of neck, and breast bright ferruginous. Abdomen ocher-yellow, shading gradually into the ferruginous color of the breast anteriorly. Back and extremities gray-buff, tinged with ferruginous on the humerus and tibia. Sides of the body below the wings chocolate-brown, which color also extends to the fur on the under side

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of the wings below the humerus, though the hairs have more or less yellowish-brown tips.

The hairs of the crown of the head are very pale yellow at the base, with darker tips. Those of the ferruginous collar are chocolate-brown at the base, except over the shoulder-glands, where they are ferruginous throughout. All the hairs of the abdomen are grayish-brown at the bases, pale about the pubis, and darker anteriorly.

The majority of the hairs of the back are pale gray at the base, with buff extremities; mingled with them are fewer dark-brown hairs.

SKULL.—Muzzle narrow. Orbits completed behind by the union of the post-orbital process with the zygomatic arch. Upper incisors close together, the outer pair nearly as large as the inner pair. Lower incisors crowded, the outer pair resting against the canines and the inner pair against these. The inner pair have about one-half the diameter of the outer pair, and are so placed that one-half their mass is external to a line joining the anterior surfaces of the outer pair. First upper premolar deciduous.

Dimensions of the body.

Measurements.	20984 / 36053 Male.* Aldabra Id.	20985 / 36054 Male.* Aldabra Id.
	mm.	mm.
Head and body	189	184
Ear, from lower margin of orifice to tip	24	25
Forearm	119	117
Thumb (without claw)	38	38.5
Hind foot (without claw)	37.5	40.0
Calcaneum	15.5	16.0

*These measurements are from the dry skins. Dr. Abbott gives the following dimensions for the same specimens when fresh:

Measurements.	20984	20985
Length	9 in.	9½ in.
Expanse	39 in.	40½ in.

Dimensions of the skull.

Measurements.	36053 / 20984	36054 / 20985
	mm.	mm.
Basi-cranial length	52.5	53.0
End of palate to post. base of incisors	31.0	32.0
Breadth of palate between inner margins of first molars	9.4	10.0
Extremity of nasals to anterior margin of orbit	17.3	18.0
Greatest diameter of orbit	11.7	11.6
Greatest zygomatic breadth	33.5	33.6
Length of penultimate upper molar	4.2	4.2
Length of last upper molar	2.0	2.0
Length of mandible, from condyles to anterior surface of incisors	44.0	45.0

NOTICE OF THE CRUSTACEANS COLLECTED BY THE UNITED STATES SCIENTIFIC EXPEDITION TO THE WEST COAST OF AFRICA.

BY

JAMES E. BENEDICT,

Assistant Curator of the Department of Marine Invertebrates.

The crustaceans enumerated in this paper were obtained by W. Harvey Brown and his brother, Arthur H. Brown, during the voyage of U. S. S. *Pensacola* on the recent eclipse expedition to St. Paul de Loanda on the west coast of Africa. The ship sailed from New York on the 16th of October, 1889, stopping on the way at the Azores and the Cape de Verde Islands, also at Free Town and Elmina on the Gold Coast, arriving at its destination on the 6th of December. After the eclipse the ship sailed for Cape Town and then homeward, stopping at the Island of St. Helena, Ascension Island, and Barbados. For the sake of completeness, the few things obtained at this American locality are included in the list.

The collection, though not large, is as extensive as could be expected where men were collecting in all departments in the limited time allowed in the different ports. With the exception of a variety of *Callinectes tumidus* Ordway, none of the Brachyura are believed to be new. However, the species obtained are valuable to the Museum collection, in every case adding a species or a locality previously unrepresented.

BRACHYURA.

Family PERICERIDÆ.

Microphrys bicornutus (Latreille).

Pisa bicornuta Latreille, Ency. Meth. Hist. Nat., x, p. 141, 1825.
Pericera bicorna Milne Edwards, Hist. Nat. des Crust., I, p. 337.
Milnia bicornuta Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 180, 1860.
Microphrys bicornutus A. Milne Edwards, Crust. in Miss. Sci. au Mexique, p. 61, pl. XIV, figs. 2, 3, and 4, 1873.

Barbados, May 8, 1890. One specimen.

Mithrax sculptus (Lamarck).

Maia sculpta Lamarck, Hist. des Anim. sans Vert., v, p. 242.
Mithrax sculptus Milne Edwards, Hist. Nat. des Crust., I, p. 322. Miers, Challenger Report, Zoöl., XVII, p. 87, 1886.
Mithraculus sculptus Stimpson, Bull. Mus. Comp. Zoöl., II, p. 117, 1870.

Barbados, May 8, 1890.

Family CANCRIDÆ.

Actæa rufopunctata (Milne Edwards).

Xantho rufopunctatus Milne Edwards, Hist. Nat. des Crust., I, p. 389.
Actæa rufopunctata A. Milne Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, I, p. 268, pl. XVIII, fig. 1, 1*a*.

Ascension Island; one young specimen.

Leptodius americanus (Saussure).

Chlorodius americanus Saussure, Crust. Nouv. Antilles et Mexique, p. 14, pl. I, fig. 5.
Xanthodius americanus Stimpson, Ann. Lyc. Nat. Hist. N. Y., p. 209, 1860.
Leptodius americanus A. Milne Edwards, Crust. in Miss. Sci. au Mexique, p. 269, 1871.

Barbados, May 8, 1890.

Leptodius floridanus (Gibbes).

Chlorodius floridanus Gibbes, Proc. Amer. Assoc. Adv. Sci., p. 175, 1850.
Leptodius floridanus A. Milne Edwards, Crust. in Miss. Sci. au Mexique, p. 268, pl. XLIX, fig. 2, 1871.

Barbados, May 8, 1890.

Eriphia gonagra (Fabricius).

Cancer gonagra Fabricius, Suppl. Ent. Syst., p. 337, 1798.
Eriphia gonagra Milne Edwards, Hist. Nat. des Crust., I, p. 426, pl. XVI, figs. 16, 17.

Barbados, May 8, 1890.

Family PORTUNIDÆ.

Genus CALLINECTES Stimpson.

Although the occurrence of the genus *Callinectes* on the west coast of Africa is well known, the specimens obtained by the eclipse expedition are the only ones in the museum collection from that region. A. Milne Edwards, in his Zoologie du Mexique, describes *Callinectes africanus* as a new variety of *C. diacanthus* from the Cape de Verde Islands. In this work he also makes all of the Ordwayan and other species of the genus mere varieties of *C. diacanthus*. Holding this view, he naturally does not point out the affinity of his variety to any of the species generally recognized on this side of the Atlantic. In January, 1863, Albert Ordway, through Dr. Stimpson, communicated to the Boston Society of Natural History his well-known monograph of the genus *Callinectes*. In this paper Mr. Ordway brings into line as distinct species the different forms long known as *Lupa hastata* Say and its synonyms, and but recently placed by Dr. Stimpson in the genus *Callinectes* erected by him for the species on account of its very narrow ⊥-shaped abdomen. Mr. Ordway, in defining the several species, used as one of the principal characters the widely different

forms of the appendages of the male abdomen. Seven of the species so defined are represented in the museum collection, and unless intermediate forms are found the value of this character is surely specific. Whatever may be the result of an exhaustive study of a large series of specimens from the widely-separated localities in which this genus is found, it would seem that for the present its study would be best advanced by regarding its principal subdivisions as distinct species.

Callinectes larvatus, var. **africanus**? (A. Milne Edwards).

Callinectes larvatus Ordway, Boston Jour. Nat. Hist., VII, p. 573, 1863.
Callinectes diacanthus var. *africanus* A. Milne Edwards, Crust. in Miss. Sci. au Mexique, p. 229.

A large male was taken in the Beyah River, Elmina, Ashantee, November 27, and two large males were also obtained at St. Paul de Loanda, December 11, 1889.

These specimens agree so well with a large series from Key West that they can be separated only by the color, the African specimens being purple above and the American a horn color which can not be accurately described from specimens so long in alcohol. The hands agree in color, both having dark fingers set with red teeth.

A young female without chelipeds taken at Porto Grande, November 11, seems to belong to this variety.

Callineotes tumidus Ordway, var. **gladiator**, nov.

Callinectes tumidus Ordway, Boston Jour. Nat. Hist., VII, p. 574, 1863.

A small individual referable to this species was taken November 27 in the Beyah River. Although not more than one-half the size of *C. larvatus* from the same place, the intromittent organs are much longer and are curved and hooked, as in *tumidus*. The segments of the abdomen are the same. The last article of the fifth pair of legs is tipped with black, as in *tumidus*. The variety is made on account of the longer lateral spines and the less convex carapace.

Platyonychus bipustulatus Milne Edwards.

Arch. du Mus., X, p. 413, and synonymy.

Cape Town, February, 1890.

Family GEOCARCINIDÆ.

Geocarcinus lagostoma Milne Edwards.

Hist. Nat. des Crust., ii, p. 27; Miers, Challenger Report, Zoöl., p. 218, pl. XVIII, fig. 2.

A fine male was taken at Ascension Island, March 21. Miers gives a good figure of a female from the same locality and refers it to this species with a question as to its identity. The identity of our specimen depends on that of Miers.

Family OCYPODIDÆ.

Ocypoda cursor (Linné).

Cancer cursor Linné, Syst. Nat., ed. xii, p. 1039.
Ocypoda cursor de Haan, Fauna Japon., Crust., p. 29.

St. Paul de Loanda, December 11.

Gelasimus tangieri Eydoux.

Mag. de Zool., Cl. VII, notice XVII, pl. 14, 1835.

Beyah River, Ashantee, November 27; St. Paul de Loanda, December 11.

Gelasimus perlatus Herklots.

Additamenta ad Faunam, p. 16, 1851.

One male taken at St. Paul de Loanda, December 11, agrees with descriptions and figures.

Family GRAPSIDÆ.

Grapsus maculatus (Catesby).

Pagurus maculatus Catesby, Nat. Hist. of the Carolinas, II, pl. XXXVI.
Grapsus maculatus Milne Edwards, Ann. Sci. Nat., p. 187, pl. VI, fig. 1, 1853.

Ascension Island; Fayal, Azores. A very small specimen from the Cape de Verde Islands may also belong to this species.

Goniopsis cruentatus (Latreille).

Grapsus cruentatus Latreille, Hist. Nat. des Crust. et Ins., VI, p. 70.
Goniopsis cruentatus de Haan, Fauna Japonica, Crust., p. 33.

Ashantee, November 27.

Pachygrapsus marmoratus (Fabricius).

Cancer marmoratus Fabricius, Ent. Syst., II, p. 450.
Pachygrapsus marmoratus Stimpson, Proc. Acad. Nat. Sci. Phila., p. 102, 1858.

Fayal, Azores, November 2.

Pachygrapsus transversus Gibbes.

Proc. Amer. Assoc. Adv. Sci., III, p. 182, 1850.

Porto Grande, Cape de Verde Islands, November 11.

Sesarma africana Milne Edwards.

Hist. Nat. des Crust., II, p. 73, 1837.

Beyah River, Ashantee.

Plagusia depressa Say.

Jour. Acad. Nat. Sci. Phila., I, p. 100, 1815.

Beyah River, Ashantee, November 11.

ANOMURA.

Family HIPPIDÆ.

Remipes scutellatus (Fabricius?).

Ascension Island.

Family PORCELLANIDÆ.

Petrolisthes magnifica (Gibbes).

Porcellana polita Gray, Zool. Misc., p. 14, 1830. Griffiths, Cuv. Crust., p. 312, pl. XXV, fig. 2, 1833.
Porcellana magnifica Gibbes, Proc. Amer. Assoc. Adv. Sci., p. 191, 1850; Proc. Elliott Soc., p. 6, pl. 1, fig. 3, November, 1853.
Petrolisthes politus Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 74, 1860.

Dr. Stimpson regarded this as a synonym of *P. politus* of Gray, but Gray's description is inadequate and the figure of Griffiths does not help the identification, and unless the type is extant it would seem best to retain Dr. Gibbes's name.

Color in alcohol: Carapace light brick-red. When the surface is magnified innumerable punctures are brought to view, the position of each puncture marked by a very small light colored spot invisible except under the lens. The merus joints of the ambulatory legs are colored the same as the carapace, but under the lens are more conspicuously and irregularly spotted or blotched. The carpal joints are a little darker. The propodal joints are a deep red, darkest near the distal end, which is abruptly light. The dactyls are light, each with a deep red ring in the middle. The chelipeds are a deeper red than the carapace. The tips of the fingers are crimson with the subterminal portion black.

Barbados.

Family PAGURIDÆ.

Calcinus sulcatus (Milne Edwards).

Pagurus sulcatus Milne Edwards, Ann. des Sci. Nat. (2), VI, p. 279; Hist. Nat. des Crust., II, p. 230, 1837. See also Dr. Hilgendorf in Monatsberichte der K. P. Akad. zu Berlin, 1878.

Dr. Hilgendorf shows that Herbst's description agrees better with *sulcatus* than with the *tibicens* of the eastern seas, and refers a *Calcinus* from Mozambique to the *tibicens* of Edwards *nec* Herbst. Prof. Henderson, in the Challenger Anomura, p. 61, quotes Dr. Hilgendorf, but refers a *Calcinus* to Herbst's species *tibicens*. If the West Indian species was the one described by Herbst, that name must eventually be adopted for it. The eastern species would perhaps take the name given by Randall, *Pagurus levimanus* (Jour. Acad. Nat. Sci. Phila., VIII, p. 135, 1839).

Barbados.

Clibanarius, sp.

Fayal, Azores.

MACRURA.

Family PALINURIDÆ.

Panulirus guttatus (Latreille), var., Bate.

Palinurus guttatus Latreille, Ann. du Museum, III, p. 393.
Panulirus guttatus, var. Bate, Voyage of the Challenger, Macrura, p. 78, pl. X*a*.

One large specimen of this species, agreeing very well with the variety described by Bate, was obtained at Porto Grande, November 12.

Panulirus spinosus (?) Milne Edwards.

Hist. Nat. des Crust., p. 298.

Two females with eggs, Porto Grande, November 12.

Family PALÆMONIDÆ.

Palæmon jamaicensis? Herbst.

Milne Edwards, Hist. Nat. des Crust., II, p. 398, and synonymy.

Ten specimens from the Quanza River at Cunga. In comparison with specimens from the island of Old Providence, West Indies, they are a little more slender, the teeth of the inner margin of the fingers are larger, and the spines of the first pereiopod are coarser. They agree more closely with much larger specimens from Nicaragua. It is possible that a large amount of material from these widely separated localities would give sufficient data to divide the species into varieties. The length of the largest specimen, from the tip of the rostrum to the end of the telson, is 152 millimeters; length of the left anterior pereipod, 192 millimeters.

Family PENÆIDÆ.

Penæus brasiliensis Latreille.

Nouv. Dict. Hist. Nat., XXV, p. 156, 1817. Miers, Proc. Zoöl. Soc. London, pp. 299, 306, 1878.

A number of specimens of this species are in the collection from Elmina, Ashantee. Miers says that "specimens from Whydah, on the west coast of Africa, agree in all respects with authentic specimens from Brazil." Our specimens range from 65 to 90 millimeters in length. They correspond with Miers's description, and compared with specimens from off Trinidad, West Indies, agree well, except that the latter have only nine teeth on the rostrum, while the former have ten. In the Trinidad specimens the longitudinal sulci do not extend quite so near to the posterior border of the cephalothorax and do not end in little pits, as is the case with those from Elmina.

ISOPODA.

Family ONISCIDÆ.

Porcellio, sp.

St. Helena; Azores.

Family IDOTÆIDÆ.

Idotea, sp.

Cape Town.

Family SPHÆROMIDÆ.

Sphæroma, three species.

Cape Town.

AMPHIPODA.

Undetermined genus and species.
Cape Town.

PHYLLOPODA.

Family APODIDÆ.

Apus, sp.

Pond, St. Paul de Loanda.

A DESCRIPTIVE CATALOGUE OF THE HARVEST-SPIDERS (PHALANGIIDÆ) OF OHIO.

BY

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(With Plates LVII–LXIX.)

The present paper is based upon a study of a large collection of harvest-spiders from all parts of Ohio, gotten together during the writer's connection with the Ohio Agricultural Experiment Station from 1888 to 1891. Most of the specimens were taken, by myself or my assistants, in Franklin County, in the central part of the State, but good series were also obtained from Butler, Cuyahoga, Fairfield, Fulton, and Warren counties, so that all the regions of the State are fairly well represented.

The Phalangiid fauna as a whole is quite similar to that of Illinois, which I catalogued in 1887.* It is very much richer in species than either New Hampshire on the north (six species) or Mississippi on the south (three species), both of which I have recently treated of.† The family seems to reach its maximum development in the latitude of central and southern Ohio.

The figures accompanying were drawn by Miss Freda Detmers, under my direction. Most of them have been used in previous papers, but some appear here for the first time. The localities are given by counties.

Family PHALANGIIDÆ.

Subfamily PHALANGIINÆ.

Members of this subfamily are Arachnids having the body composed of a single piece, and long, slender legs. The teguments are not coriaceous, though often quite solid. The segments are only indicated by striæ, which are often obsolete. There are five ventral abdominal segments; a single anal piece, and two distinct lateral pores on the upper margin of the cephalothorax. The maxillary lobe of the palpus has two tubercles, and the epistoma is in the form of an elongated triangular plate.

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* Bull. Ill. St. Lab. Nat. Hist., III, 97.

† Trans. Am. Ent. Soc., XIX, 261; Psyche, VI, 425.

The three genera found in Ohio may be distinguished as follows:

I.—First joint of mandibles with a tooth on ventral surface near base,

A.—Maxillary lobes of second pair of legs with a large base, impressed, straight and elongated, not attenuate, but rather a little enlarged from the base to the apex and very obtuse; claw of palpus denticulate ....*Liobunum*.

B.—Maxillary lobes of second pair of legs forming elongated triangles, quite large at the base, then gradually retracted, not impressed, with anterior border straight; claw of palpus not denticulate ....*Mitopus*.

II.—First joint of mandibles without tooth..........................*Phalangium*.

Liobunum C. Koch, 1839.

Anterior and lateral borders of the cephalothorax smooth. Eye eminence rather small; smooth, or provided with small, slightly distinct tubercles; widely separated from the cephalic border. Lateral pores small, oval, and marginal. Anal piece large, transverse-oval or semicircular, much wider than long, and much wider than the reflected borders of the eighth segment. Mandibles short, similar in the two sexes; first joint furnished at the base below with an acute tooth. Palpi simple; femur, patella, and tibia without any process and without projecting angles; maxillary lobe provided at the base with two strong conical teeth. Maxillary lobe of the second pair of legs very long, nearly straight from the base, not attenuated, directed mesad nearly horizontally, and united on the ventro-meson to the lobe from the opposite side without forming a sensible angle; the two together lightly arched on the cephalic border, and forming an even curve. Sternal piece large, slightly contracted between the fourth pair of coxæ, gradually enlarging and obtusely truncate cephalad. Legs very long and slender; tibia of the second pair with a few false articulations. Palpal claw denticulate.

The species of Liobunum found in Ohio, with the exception of *L. bicolor*, may be distinguished by the following artificial key, which applies especially to the males. I have not seen mature specimens of this sex of *L. bicolor*, and so have not included it:

1. Femur of front leg shorter than body.................................. 3
2. Femur of front leg longer than body.................................. 5
3. Dorsum grayish-brown, spotted ....*maculosum*
4. Dorsum reddish-brown, not spotted ....*grande*
5. Femur of palpus with a distinct spur on its outer ventro-lateral angle ....*calcar*
6. Femur of palpus without a spur 7
7. A distinct black longitudinal central marking on dorsum................... 9
8. No distinct black central marking.. 11
9. Second legs 70–100^{mm} in length; southern ....*vittatum*
10. Second legs 45–70^{mm} in length; northern..................*vittatum dorsatum*
11. Body and legs cinnamon or yellowish-brown ....*ventricosum*
12. Body brown, legs black 13
13. Palpi black...*nigropalpi*
14. Palpi brown 15
15. Second legs with a white ring at distal end of tibia....................*longipes*
16. Second legs black throughout 17
17. Eye-eminence with two rows of many tubercles; body small ....*politum*
18. Eye-eminence with few tubercles; body of medium size ....*nigripes*

Liobunum vittatum (Say) Weed.

(Plate LVII, Figs. 1, 2; Plate LVIII.)

Phalangium vittatum Say, Jour. Phila. Acad., II, 65; Wood, Comm. Essex Inst., VI, 20; Underwood, Can. Ent., XVII, 168.

Liobunum vittatum Weed, Am. Nat., XXI, 935; XXVI, 999; Bull. Ill. St. Lab. Nat. Hist., III, 85, 101; Psyche, VI, 426.

MALE.—Body 7mm long; 4mm wide. Palpi 7mm long. Legs: first, 44mm; second, 89mm; third, 45mm; fourth, 64mm.

Dorsum reddish-brown, with a dark central marking, commencing at eye eminence and extending backward to the ultimate or penultimate abdominal segment. Contracting slightly near the anterior margin of abdomen, then gradually expanding until about the beginning of the posterior third of the abdomen, where it again slightly contracts. Ventrum slightly paler than dorsum, both finely granulate. Eye eminence a little wider than high, black above, canaliculate, with small black tubercles over the eyes. Mandibles light yellowish-brown, tips of claws black; second joint with short sparse hairs. Palpi long, reddish-brown; tarsal joints paler. Femur and patella arched; with two rows of rather-blunt, dark tubercles on the outer ventro-lateral surface; femur also having a few small subobsolete ones on its dorsal surface. Tibia with a similar row on its outer ventro-lateral surface, a short row on the distal portion of its inner ventro-lateral surface, and a short row on the proximal portion of its ventral surface. Tarsus pubescent, with a row of short, blunt, black tubercles on its inner ventro-lateral surface, extending from the base to near the apex. Legs black; coxæ reddish-brown, minutely tuberculate; trochanters with minute scattered tubercles; femora and patellæ with rows of small spines; tibiæ with very short hairs. Shaft of genital organ slender, subcylindrical, not broadened distally, but bent at an obtuse angle and terminating in a very acute point.

FEMALE.—Body 8–9mm long; 5–6mm wide. Palpi 5mm long. Legs: first, 42mm; second, 90mm; third, 43mm; fourth, 61mm.

Besides its rounder body and much more robust appearance, it differs from the male as follows: Dorsum of a much darker shade of brown with less of the reddish tint, and the ventrum paler. Second joint of mandibles with fewer hairs. Palpi shorter, more slender, with the rows of tubercles on the tibia subobsolete, and that on the tarsus entirely wanting. Legs generally light-brown with black annulations at the articulations. Ovipositor whitish, with no dark color in apical rings.

Ohio: Lawrence, August, 1888; July, September, 1889; Warren, summer of 1889.

This abundant species is commonly found in the extreme southern counties of the State. It runs into the form described by Say as *Phalangium dorsatum*, now known as *Liobunum vittatum dorsatum*, and

* Amer. Naturalist, XXVI, 1004, in an article discussing at some length the geographical variations of this species.

it is difficult to draw the line between them. I have suggested* that it would be well to refer to *dorsatum* the forms from those localities in which the average length of the second pair of legs of the males is less than 70 or possibly 75mm. According to this division most of the forms from the central and northern portions of the State would belong to *dorsatum*.

Liobunum vittatum dorsatum (Say) Weed.

(Plate LVII, Fig. 3.)

Phalangium dorsatum Say, Jour. Phil. Acad., II, p. 66, Compl. writ., II, p. 13. Wood, Comm. Essex Inst., VI, p. 18.

Liobunum dorsatum (Say). Weed, Amer. Nat., XXI, p. 935. Bull. Ill. State Lab. Nat. Hist., III, p. 83.

Liobunum vittatum dorsatum (Say). Weed, Amer. Nat., XXVI, p. 786.

This form differs from *L. vittatum* only in its smaller body and shorter legs. The average length of legs of seventeen specimens, taken at Columbus, was as follows: Frst, 35mm; second, 69.8mm; third, 35mm; fourth, 50.2mm. A very short-legged specimen of this form, from Dakota, is shown in Fig. 3, Plate LVI.

This is perhaps the most abundant representative of the family in the central and northern part of the State. "This species evidently passes the winter in the egg state, as it has never been taken during the winter or early spring months. The eggs of the northern form apparently do not hatch very early, probably not until May, and the young grow slowly. Occasionally I have found a fully developed one during the latter part of June, but generally they do not become mature until July. My collections show two half-grown specimens taken at Columbus, Ohio, July 30, 1888, and another collected in the same locality July 16, 1888, which is not fully developed.

"When very young these harvest-men seem to prefer the shelter of the grasses, low herbage, and rubbish piles, but as they grow larger they are to be found in a great variety of situations. In the prairie regions of central Illinois, where nearly all of the country is occupied by corn fields and osage orange hedges, the young are very common on the corn plants, where, as I have elsewhere surmised, they probably live upon the numerous small insects drowned in the moisture contained in the bases of the unfolding leaves, as well as on the corn plant lice (*Aphis maidis*). The full-grown individuals are to be found nearly everywhere, on bushes and trees in the woods, in meadows and pastures, along fences, and in sheds and outhouses. They occur abundantly from July to October.

"The only opportunity I have had of studying the long-legged southern form in the field was in southern Illinois during the autumn of 1886. Along the rocky ledges running across the State and through Union County, these harvest-spiders were exceedingly abundant, occurring everywhere on the rocks and ground. They were so numerous that as one walked in the open groves on the farm of Mr. Parker Earle they would run along in droves.

"This species, like others of its family, has the power of exuding from about the coxæ a liquid with a peculiarly disagreeable odor. This doubtless serves as a protection from birds and other enemies."*

Liobunum nigropalpi (Wood) Weed.

(Plate LIX.)

Phalangium nigropalpi Wood, Comm. Essex Institute, VI, 22–23, 39.
Phalangium nigropalpi Wood. Underwood, Can. Ent., XVII, 168.
Liobunum nigropalpi (Wood). Weed, Amer. Nat., XXIV, 918; Trans. Am. Ent. Soc., XIX, 187.

MALE.—Body 6–7^{mm} long, 4^{mm} wide; palpi 5^{mm} long. Legs: first, 40–51^{mm}; second, 75–92^{mm}; third, 39–48^{mm}; fourth, 60–70^{mm}.

Body elongate, narrowed posteriorly. Dorsum reddish brown, of a nearly uniform tint, with a faint central marking, and scattered yellowish spots; minutely tuberculate. Eye eminence black, slightly canaliculate, with a row of rather small, black, distant tubercles on each carina. Mandibles light yellowish brown, tips of claws black; second joint with sparse hairs. Palpi well developed; black, except tarsus, which is brownish; a row of tubercles on outer ventro-lateral surface of femur; femur, patella, and tibia each somewhat arched; a few tubercles on lateral surface of proximal portion of patella, and a row of flattened black tubercles on the inner ventro-lateral surface of tarsus; ventral surface of tibia clothed with stiff black hairs. Ventral surface, including coxæ, of nearly the same color as the dorsum, but a little lighter; coxæ tipped with white. Legs very long and slender; trochanters dark brown, more or less blackish; rest of legs blackish. Genital organ flattened, bent with a double bow-like curve, contracted at its distal extremity, and ending in a short acute point.

FEMALE.—Body 7.5^{mm} long, 4.5^{mm} wide; palpi 5^{mm} long. Legs: first, 37^{mm}; second, 70^{mm}; third, 38^{mm}; fourth, 51^{mm}.

Differs from male as follows: Body larger, rounder; central marking more distinct; inner distal lateral angle of patella more conical; row of tubercles on tarsus of patella obsolete; legs brown rather than black.

Fairfield County, September 20, 1890. This is a rare species for Ohio. The only time I have taken it in the State was at Sugar Grove on top of a wooded hill, where I saw several specimens running about on the fallen leaves.

Liobunum nigripes Weed.

(Plate LX.)

Liobunum verrucosum (Wood). Weed, Amer. Nat., XXI, 935; Bull. Ill. State Lab. Nat. Hist., III, 88–89, 102; Amer. Nat., XXIV, 918.
Liobunum nigripes Weed, Trans. Am. Ent. Soc., XIX, 190.

MALE.—Body 6.5^{mm} long; 4^{mm} wide; palpi 4.5^{mm} long. Legs: first, 27^{mm}; second, 50^{mm}; third, 28^{mm}; fourth, 30^{mm}.

* Weed, Amer. Naturalist, XXVI, 1004.

Dorsum minutely tuberculate, almost appearing finely granulate, ferruginous brown, somewhat darker in front, with a faint indication of a dark central marking in some specimens, and indistinct transverse rows of yellowish dots. Eye eminence developed, slightly longer than high, black above, very slightly canaliculate, with two rows of small, black tubercles, frequently subobsolete. Mandibles light brown, tips of claws black; second article with sparse, dark hairs. Palpi slender, grayish or brownish in some specimens, with more or less black on basal joints; femur with short, scattered hairs; ventral surface beset with well-developed black tubercles; patella curved, with short hairs and small black tubercles; tibia and tarsus thickly beset with short hairs, without tubercles, except a subobsolete row on the inner ventro-lateral surface of tarsus. Ventrum grayish brown, cephalic portion tuberculate. Legs, including trochanters, black; trochanters tuberculate; femora, patellæ, and tibiæ with rows of small spines. Shaft of genital organ straight, except at tip, broad, flat; about two-thirds of the way from the base to the apex expanding into an alate portion, which continues for about one-fifth the entire length of the shaft, then suddenly contracting into a rather robust, curved, canaliculate end, and terminating in an acute point; with two curved spinous hairs just behind the base of the jointed tip.

FEMALE.—Body 9^{mm} long; 4^{mm} wide; palpi 4.5^{mm} long. Legs: first, 28^{mm}; second, 48^{mm}; third, 26^{mm}; fourth, 40^{mm}.

Besides its larger size the female differs from the male in the much darker color of the dorsum, which varies from dark ferruginous brown to almost black; in color of ventrum, which is grayish rather than brown; and in having the legs, except trochanters, brown rather than black.

Specimens of this species have been collected in Clermont County, August, 1890; Franklin, July 7–10, 1890; Warren, June 28, July 23, 1890.

The sexes of this species are quite unlike. In first going over my collections I separated the males in one series and the females in another, thinking them different species, but on finding that the specimens of one of the supposed kinds were all males and the others all females, and that in nearly every instance the two forms had been taken at the same time and place, I had little hesitancy in considering them the same.

During July, 1890, this form was very common in central Ohio. But it does not appear to be so in other places, as I have no specimens from any other state except Illinois.

Liobunum politum Weed.

(Plate LXI.)

Liobunum politum, Weed, Bull. Ill. St. Labr. Nat. Hist., III, p. 89; Amer. Nat., XXV. p. 295; Trans. Am. Ent. Soc., XIX, p. 266.

MALE.—Body 5^{mm} long; 2.8^{mm} wide; palpi 3.5^{mm} long. Legs: first, 25^{mm}; second, 51^{mm}; third, 26^{mm}; fourth, 36^{mm}.

Dorsum smooth, finely granulate; clear reddish brown, with no markings, except occasionally a faint indication (shown by a slightly darker shade) of the usual central dark marking. Eye eminence rather prominent, slightly constricted at base, black above, canaliculate, with a regular curved series of small, acute, black spines over each eye. Mandibles whitish, tips of claws black. Palpi slender, light brown, with femur and patella dusky; finely pubescent, with a subobsolete row of minute dark tubercles on the inner ventro-lateral surface of femur, and another row on the inner ventro-lateral surface of tarsus; joints slightly arched. Ventrum with coxæ, including the membranous distal lateral tips, and generally the trochanters, vermilion red. Legs with proximal portions light-brown; distally dark brown or blackish. Shaft of genital organ nearly straight, slender, flattened, canaliculate; distal portion very slightly expanded, then slightly contracted, and again expanded into a half spoon-shaped portion, and terminating in a small acute point.

FEMALE.—Differs from the male in having a larger, rounder body, and in the color of the dorsum, which is brown, with a rather distinct, darker central marking, and numerous whitish spots arranged more or less transversely. In some specimens the central marking is subobsolete. Apical rings of ovipositor white.

Specimens of this handsome and abundant species have been taken in the following counties of Ohio, on the dates given: Champaign, August 18, 1890; Clermont, August, 1890; Delaware, September 18, 1890; Franklin, July 9, 1889; July 7, 8, 9, 10, 27, 31; August 6, September 2, 5, 6, 9, 1890; Lawrence, September 5, 6, 1890; Madison, July 19, 1890; Scioto, Septembr 3, 1890; Warren, July 5, August 14, 16, 1890.

"This harvest spider is an out-door species, occurring abundantly in fields and woods, although seldom found about barns and outhouses. During the past summer (1890) I have taken great numbers in Franklin County, Ohio, in the grass along the banks of a small creek, and among the driftwood left by the overflowing of the Olentangy River. The species becomes fully developed early in July, and the males and females are about equally abundant. Both sexes when disturbed emit from the coxal region a liquid having a peculiarly sharp, pungent odor.

"I placed a number of these harvest spiders in a large glass vivarium July 10, 1890. Two days afterward a pair were observed mating. They were standing on one of the vertical sides of the vivarium, facing each other. The male kept waving his second pair of legs in the air; his body was somewhat more elevated than that of his mate, being inclined downward and forward, while that of the latter was inclined upward in front. Similar observations were subsequently made on many other individuals. When alarmed both sexes have a habit of standing on six legs, rapidly vibrating the body and moving the second legs in

a partial transverse circle in the air. In confinement they eagerly devour plant lice."*

In New England I have taken this species oftenest while sweeping the insect net over grass lands.

Liobunum longipes Weed.

(Plate LXII, Fig. 1.)

Liobunum nigropalpi (Wood). Weed, Am. Nat. XXI, 935, Bull. Ill. St. Lab. Nat. Hist., III.
Liobunum longipes Weed, Am. Nat., XXIV, 918; Trans. Am. Ent. Soc., XIX, 265.

MALE.—Body 4^{mm} long, 3^{mm} wide. Palpi 4^{mm} long. Legs: first, 41–49^{mm}; second, 82–99^{mm}; third, 43–50^{mm}; fourth, 59–67^{mm}.

Dorsum minutely tuberculate, reddish brown, with a slightly darker, subobsolete, central marking, sometimes simply represented by obscure, brown blotches. Eye eminence at least as broad as high, black above, canaliculate, with rows of small, black tubercles on the carinæ. Mandibles light yellowish brown, tips of claws black; second joint with sparse hairs. Palpi slender, light brown, distal portion of femur and almost all of patella, usually a little darker. sometimes almost black; femur, patella, and tibia with small scattered tubercles and short hairs; tarsus pubescent, with a row of small, black tubercles on its inner ventrolateral surface. Ventrum, including coxæ, paler than dorsum, of a nearly uniform, light brown tint; coxæ tuberculate, tips white; trochanters black. Legs very long, slender, black or brownish black; generally though not always with apical tenth of tibiæ of second pair white; shaft of genital organ flattened, contracted near its distal extremity and bent upward, terminating in an acute point.

FEMALE.—Body 6^{mm} long; 4^{mm} wide. Palpi 4^{mm} long. Legs: first 39^{mm}; second, 72^{mm}; third, 40^{mm}; fourth, 51^{mm}.

Besides its larger body and shorter legs it differs from the male in having the dorsum slightly smoother, with more or less dark markings, and the central marking more distinct.

Ohio: Clermont, August, 1890; Fairfield, September, October, 1890; Franklin, August 6, 1890.

The females of this form are rare. I have a single specimen taken in Fairfield County during October which may be a fully developed female of this species: its body is large and swollen by eggs. Its legs are dark brown with white annulations at all the joints, including those of tarsi, and a transverse white blotch on dorsum of abdomen. If this is the female *longipes* the forms with plain brown legs must be immature conditions of it.

Liobunum ventricosum (Wood) Weed.

(Plate LXIII.)

Phalangium ventricosum Wood, Comm. Essex Inst., VI. 32, 33, 39, fig. 7.
Phalangium ventricosum Wood. Packard's Guide to the Study of Insects, p. 657, fig. 633.
Phalangium ventricosum Wood. Underwood, Can. Ent. XVII, 169.

* Weed. Amer. Nat., XXV, 296.

Liobunum (?) *ventricosum* (Wood). Weed, Amer. Nat., XXI, 935.
Liobunum (?) *ventricosum* (Wood). Weed, Bull. Ill. State Lab. Nat. Hist., III, 101.
Liobunum ventricosum (Wood). Weed, Amer. Nat., XXIV, 918: Trans. Am. Ent. Soc., XIX, 188.

MALE.—Body 7mm long; 5mm wide; palpi 6mm long. Legs: first 35mm; second, 68mm; third, 35mm; fourth, 53mm.

Body elongate; abdomen conical or pear-shaped. Dorsum, legs including trochanters, and palpi varying from dark cinnamon-brown to ferruginous brown, most commonly cinnamon rufous. Ventrum light grayish brown. Dorsum closely granulate with an indistinct darker marking, and numerous small grayish spots arranged in irregular transverse series. Eye eminence black, except at base; rounded, not caniculate, smooth, or with a few small, acute tubercles. Palpi rather slender, with none of the angles prolonged; femur with a very few small spinous tubercles and hairs; patella strongly, and femur and tibia slightly arched; coxæ minutely tuberculate, tipped with white; trochanters and legs cinnamon rufous; tarsi dusky. Legs long and moderately robust. Genital organ of male "flat, nearly straight, slender at the basal portion, gradually widening and distally rather quickly expanded into a broad alate portion, and then abruptly contracted into a moderately robust, slightly curved point, which is placed at an angle to the rest of the shaft; at the base of the point a marked notch in the end of the shaft.

FEMALE.—Body 10.5mm long; 5.5mm wide; palpi 5mm long. Legs: first, 32mm; second 62mm; third, 32mm; fourth, 45mm.

Differs from the male in the very much larger size of its body. The abdomen in most specimens is greatly swollen, especially below.

Ohio: Franklin County, June 13, 1889; July 8, 1890; September 25–30, 1888; Warren County, August 7, 1890.

The immature form of this species was described by Wood as *Phalangium formosum*, and was later referred by myself to the genus Forbesium. The young occur rather commonly during autumn, winter, and spring, under boards and logs, being very much more abundant than I have ever found the adults. They become mature early in June.

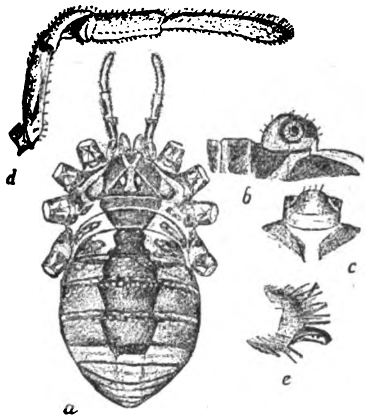


Fig. 1.—*Liobunum ventricosum*. Immature: *a*, body; *b*, eye eminence, side view; *c*, same, front view; *d*, palpus; *e*, palpal claw; all magnified.

This immature form as found in spring shortly before maturity is represented in fig. 1, and is described as follows:

Dorsum remarkably smooth, mottled with gray and blackish brown; a wide, dark brown or black central marking commences on the cephalic margin and runs to the middle of the fifth abdominal segment, where it abruptly terminates; it is expanded

on the cephalothorax, contracted on the first abdominal segment, and then again expanded. The entire abdomen caudad of the middle of the fifth segment usually much lighter than the part cephalad. There is a peculiar oblique sinus caudad of each lateral pore. Eye eminence brownish, perfectly smooth, not at all canaliculate, almost hemispherical. Mandibles whitish, with the usual black tips to the claws; second article with sparse blackish hairs on dorsal surface. Palpi rather slender, mottled, distally whitish; furnished with short blackish hairs. Patella with its inner distal lateral angle prolonged into a short apophysis, and having a rather thin brush of hairs on its inner lateral surface. Tarsal claw denticulate. Ventrum, including coxæ, grayish brown, cephalic portion with short dark hairs. Trochanters brownish black. Legs light brown, ringed with dark brown; furnished with very minute blackish spines.

Liobunum bicolor (Wood) Weed.

(Plates LXIV and LXV.)

Phalangium bicolor Wood, Comm. Essex Institute, VI, 28. 39.
Phalangium bicolor Underwood, Can. Ent., XVII, 168.
Liobunum (?) bicolor Weed, Amer. Nat., XXI, 935.
Liobunum (?) bicolor Weed, Bull. Ill. St. Lab. Nat. Hist., III, 103.
Liobunum elegans Weed, Bull. Ill. St. Lab. Nat. Hist., III, 89, 102.
Astrobunus (?) bicolor Weed, Amer. Nat., XXXIV, 918.
Liobunum elegans Weed, Amer. Nat., XXXIV, p. 918.

FEMALE.—Body 4^{mm} long, 2.5^{mm} broad. Legs: first, 24^{mm}; second, 48^{mm}; third, 24^{mm}; fourth, 37^{mm}.

Dorsum blackish, with a faint indication of a lighter central marking; a large triangular reticulated patch on the cephalothorax, the posterior portion including the eye eminence; behind this is a smooth grayish black space which is interrupted by a transverse reticulated band parallel with the front of the posterior coxæ; a large quadrangular reticulated brown patch on the central portion of the abdominal dorsum, behind which are two other transverse reticulated bands. There are also on the dorsum of the abdomen more or less distinct transverse rows of whitish tubercles with black tips. Segmentation between cephalothorax and abdomen and between segments of latter obsolete. Eye eminence prominent, dark brown, canaliculate, with a row of well-developed acute brown tubercles on each carina. Mandibles light yellowish brown, with very little black on claws; tooth on lower surface of first joint distinct; both joints smooth, with only a few indistinct whitish hairs. Palpi light brown, with femur and tibia more or less dusky; all joints except tarsi with numerous small spinose tubercles. Ventral surface, including coxæ, whitish brown; a transverse row of minute tubercles on each abdominal segment. Coxæ closely tuberculate. Trochanters grayish. Legs light brown, very slender, long; proximal joints with rows of acute conical tubercles.

In Dr. Wood's description the patches mentioned above are spoken of as consisting of "close, small black tubercles," but under a high power they are seen to have a reticulate surface.

Ohio: Franklin, October 2, 1889; October 13, 1890; Henry, August 18, 1890 (immature).

An examination of more than fifty specimens of a harvest spider in various stages of development, taken along the banks of the Maumee River, in Henry County, August 18, 1890, leads to the conclusion that the form from Illinois described some years ago as *Liobunum elegans* is an immature stage of the male of the present species. I have never found any adult males. The forms described as *elegans* are illustrated in Plate LXV and their description is as follows:

MALE.—Body, 3.2^{mm} long, 2.1^{mm} wide. Palpi, 2.1^{mm} long. Legs: first, 19^{mm}; second, 38^{mm}; third, 20^{mm}; fourth, 29^{mm}.

Dorsum blackish at the margins, especially on the abdomen, and light brownish in the middle, with a faint indication of a central marking. Finely granulate, with numerous very small black tubercles scattered in patches over the surface and a transverse row of large whitish tubercles on each abdominal segment. Eye eminence prominent, light brown, darker above; canaliculate, with two rows of well developed tubercles having whitish bases and black tips. Mandibles whitish, tips of claws black. Palpi slender, light brown. Femur, patella, and tibia, with distant short spinose tubercles. Tarsus with whitish hairs. Ventrum whitish brown, with a transverse row of tubercles on each abdominal segment, and the pectus and coxæ closely tuberculate. Legs very slender, proximal portions light brown, distally darker. Femora furnished with minute blackish spines.

Liobunum calcar (Wood) Weed.

Phalangium calcar Wood, Comm. Essex Institute, VI, 26–27, 39.
Phalangium calcar Wood. Underwood, Can. Ent., XVII, 168.
Liobunum (?) *calcar* (Wood). Weed, Amer. Nat., XXI, 935.
Liobunum (?) *calcar* (Wood). Weed, Bull. Ill. St. Lab. Nat. Hist., v. III, 90–91, 102–103.
Liobunum (?) *calcar* (Wood). Weed, Amer. Nat., XXIV, 918.

MALE.—Body 7.5^{mm} long; 4.5^{mm} wide; palpi —^{mm} long. Legs: first, 31^{mm}; second, 56^{mm}; third, 33^{mm}; fourth, 40^{mm}.

Dorsum reddish-brown; minutely tuberculate; some specimens having a faint indication of a central marking and scattered light-colored spots. Eye eminence well developed; of nearly equal height, length, and breadth; blackish above; slightly canaliculate, with a row of small, acute tubercles on each carina. Mandibles yellowish-brown, with obscure markings of a darker color, especially on the inner dorso-lateral surface of the second joint, where they are sometimes arranged in the form of a series of irregular parallelograms; dorsal surface of second joint sparsely clothed with stiff hairs; tips of claws black. Palpi long, very robust, dark reddish-brown, lighter distally. Femur enlarging from base to apex, with a very robust spur-like process on its outer, ventro-lateral surface near the distal extremity, the anterior edge of the spur being provided with a row of short black tubercles; a few similar tubercles on the proximal portion of the inner ventro-lateral surface; sparsely provided with spinose hairs. Patella short,

thick, so united with the femur as to form an arch, with sparse hairs and a few scattered tubercles on its dorsal and outer-lateral surfaces; tibia arched, densely clothed with long, black hairs; a patch of short, black tubercles on the proximal portion of its ventral surface, and a short row of similar tubercles on the apical portion of its inner, ventro-lateral surface; tarsus clothed with long, black hairs, with a row of short, black tubercles on its inner ventro-lateral surface, terminating in a short, denticulate claw. Ventrum light reddish-brown. Coxæ reddish, with a few short hairs; two front pairs with a row of subobsolete tubercles on the anterior border. Trochanters light brown, darker above; remaining joints of legs reddish-brown with darker annuli; femora, patella, and tibia having rows of short spines. Shaft of genital organ very robust, flattened, distally curved and suddenly contracted, and terminating in a short, acute point.

Described from several Illinois specimens. This is a rare form of which the female is yet unknown. The species does not strictly belong to Liobunum on account of the process on the femur of the palpus, but as this may be merely a sexual peculiarity not possessed by the female, I leave it in that genus for the present. I have a single specimen collected on Catawba Island by Mr. J. S. Hine.

Liobunum maculosum (Wood) Weed.

(Plate LXVI.)

Phalangium maculosum Wood, Comm. Essex Inst., VI, 31–32, 40.
Phalangium maculosum Wood., Underwood, Can. Ent., XVII, 168.
Phalangium (?) maculosum Wood. Weed, Bull. Ill. State Lab. Nat. Hist., III, 104.
Liobunum maculosum (Wood). Weed, Amer. Nat. XXIV, 918; Trans. Am. Ent. Soc., XIX, 191.

MALE.—Body 8^{mm} long; 4.5^{mm} wide; palpi 5.5^{mm} long. Legs: first, 19^{mm}; second, 33^{mm}; third, 21^{mm}; fourth, 26^{mm}.

FEMALE.—Body 11^{mm} long; 6^{mm} wide; palpi 5^{mm} long. Legs: first, 16^{mm}; second, 32^{mm}; third, 20^{mm}; fourth, 27^{mm}.

Body large; dorsum granulate, cinnamon-brown, with an indistinct darker, vase-shaped central marking, beginning at the eye eminence, contracting slightly on the first abdominal segment, and then slightly expanding and running with nearly parallel sides to the posterior extremity; a great many small yellow spots on the abdominal segments arranged in irregular transverse series (in the male under examination there is on the front margin of the middle of the first abdominal segment, and between that and the eye eminence on the cephalothorax, transverse masses of minute golden dots); in front of eye eminence is a whitish V-shaped mark. Eye eminence well developed; black, except a whitish spot at the base both in front and behind; contracting from base upward; scarcely canaliculate; with two subobsolete rows of blackish tubercles. On the front margin of the cephalothorax, directly in front of the eye eminence, is a patch of three rows of small

black tubercles, sometimes subobsolete; other similar, but smaller tubercles are scattered near the rest of the margin of the cephalothorax. Mandibles brownish white, with tips of claws deep black. Ventral surface of palpi very light brown, almost white; dorsal surface brown, femur and patella darker than the rest; inner distal angle of femur and patella slightly prolonged in female, scarcely so in male: femur, patella, and tibia furnished with rows of spinous tubercles, which on tarsus are represented by similar, but more numerous rows of stiff spines. Ventral surface very light brown, almost whitish; coxæ tuberculate, same color as rest of ventrum. Trochanters black, rest of legs cinnamon-brown, darker at articulations; proximal joints having numerous spinose tubercles. Genital organ of male "robust, somewhat flattened, distally alate, bent through its entire length with a double, bow-like curve; at its distal extremity blunt, not bent, with a sharp, slender, straight, projecting point."

Warren County; Lawrence County, July, 1889. A rare form, bearing a close general resemblance to *L. grande.* It is possible that it is an immature form of *grande.*

Liobunum grande (Say) Weed.

(Plate LXVII.)

Phalangium grandis Say, Jour. Phil. Acad. Nat. Sci., II, 67; Compl. Writings, II, 14.
Phalangium grande Say. Wood, Comm. Essex. Inst., VI, 34, 40.
Phalangium grande Say. Underwood, Can. Ent., XXIV, 168.
Phalangium (?) *grande* Say. Weed, Bull. Ill. State Lab. Nat. Hist., III, 105.
Astrobunus (?) *grande* (Say). Weed, Amer. Nat., XXIV, 917.
Liobunum grande (Say). Weed, Trans. Am. Ent. Soc., XIX, 192.

MALE.—Body 9^{mm} long; 5^{mm} wide; palpi 6^{mm} long. Legs: first, 21^{mm}; second, 36^{mm}; third, 23^{mm}; fourth, 32^{mm}.

Dorsum minutely tuberculate, with numerous larger, black, spinose tubercles scattered thickly over the surface, being especially numerous on the cephalothorax and anterior portion of abdomen and occurring in a dense quadrangular patch just in front of eye eminence. Dorsum varying from ferruginous-brown to almost black, with numerous small, yellowish, not very distinct spots on the abdomen, arranged in irregular transverse series, sometimes subobsolete, having a dark-brown central vase-shaped marking beginning at the sides of the eye eminence, where it is quite broad, and contracting until it reaches the middle of the first abdominal scutum, then gradually expanding to the middle of the abdomen, then again gradually contracting toward posterior extremity; this band sometimes obsolete, or nearly so. Eye eminence black, prominent, rounded, somewhat canaliculate, each carina usually having a row of five or six well-developed, acute, black, conical tubercles. Segmentation of cephalothorax with abdomen not very distinct, and of anterior abdominal segments nearly obsolete. Palpi dull yellowish-brown, often mottled with black, especially on

patella and tip of femur; rather long, slender, with the inner distal angle of patella sometimes slightly prolonged; joints slightly arched, especially patella; femur, patella, especially on dorsal surface, and tibia, furnished with numerous black, spinose tubercles and hairs; tarsus furnished with hairs, and with a row of tubercles on its inner ventro-lateral surface. Mandibles light yellowish brown, tips of claws black; second joint furnished with numerous stiff, blackish hairs. Ventrum light brown or grayish; sides of pectus and coxæ tuberculate; trochanters black, tuberculate; remaining portions of legs dark brown, except the joints and tarsi, which are blackish. Genital organ similar to that of *L. maculosum*.

FEMALE.—Body 12^{mm} long; 6.5^{mm} wide; palpi 6^{mm} long. Legs: first, 20^{mm}; second, 35^{mm}; third, 21^{mm}; fourth, 28^{mm}.

Differs from the male in its larger body, especially the abdomen, and in having fewer tubercles on the dorsum and palpi.

Ohio: Franklin County, August 4, 1890; Fulton County, August, 1890; Lawrence County, July, 1889, September 5, 1890; Warren County, July 5, 18, August, 1890.

Liobunum grande (Say) var. *simile* Weed.

Liobunum similis Weed, Amer. Nat. XXIV, 918; Trans. Am. Ent. Soc. XIX, 193.

MALE.—This variety is at once distinguished by the deep black color of the palpi and mandibles. It does not differ in other respects from normal grande.

Ohio: Cuyahoga County, August, 1889; Butler County, September, 1890. I have not yet seen any females having the markings of this variety.

Mitopus Thorell, 1876.

First joint of mandibles with a strong tooth on ventral surface near base. Maxillary lobes of the second pair of legs in the form of elongated triangles, large at base, anterior border straight Claw of palpus not denticulate. The body teguments are soft or subcoriaceous, and the anterior border of the cephalothorax in our species is provided at the middle with three small geminated points. The dorsal surface is provided usually with small teeth, which, on the abdomen, are arranged in transverse series. The eye eminence is of medium size, about as wide as long, lightly canaliculate, and provided with two series of low tubercles.

But two American species have been described, both of which are found in Ohio. They may be distinguished thus.

Legs mottled gray, not pinkish .... *pictus*.
Legs with a distinct pinkish tinge .... *ohioensis*.

Mitopus pictus (Wood) Weed.

(Plate LXII, Fig. 2.)

Phalangium pictum Wood, Comm. Essex Inst., VI, 30–31.
Oligolophus pictus (Wood). Weed, Amer. Nat., XXI, 35.
Oligolophus pictus (Wood). Weed, Bull. Ill. St. Lab. N. H., III, 95–97.
Mitopus pictus (Wood). Weed, Amer. Nat., XXVI, 528.

MALE.—Body 5^{mm} long, 3.2^{mm} wide; palpi, 4.1^{mm} long. Legs: first, 11^{mm}; second, 27^{mm}; third, 13^{mm}; fourth, 20^{mm}.

Dorsum minutely scabrous, mottled ash-gray, much lighter in some specimens than others. Dark central marking generally very distinct, commencing at the anterior border of the cephalothorax, the dorsal surface of which it almost covers, and suddenly contracting at its posterior margin, so that it starts on the abdomen as a narrow line, slightly wider than the eye eminence, then gradually expanding until it reaches the end of the anterior third of the abdomen, where it suddenly contracts, its borders irregularly curving toward the dorso-meson, then expanding again, though not becoming as wide as before, and finally gradually contracting and running as a stripe to the last segment, or, as in some specimens, simply terminating at the anterior margin of the penultimate segment. Anterior margin of cephalothorax nearly straight, lateral angles slightly produced, each having a black spine on an elevated base; three large brownish black, tooth-like processes just back of the middle of the margin, each terminating with a minute spine, the middle process being slightly in front of the others. Back of these, but in front of the eye eminence, there is a curved series of minute spines on whitish elevated bases, and back of the eye eminence, on the cephalothorax, there are two similar nearly transverse series. There is also a similar transverse series on each segment of the abdomen most easily seen on the black central marking. Eye eminence large, brownish, canaliculate; each carina having four thick, brownish tubercles, each of which terminates in a black spine. Mandibles light brown, tips of claws black; dorsal surface of second joint and of apical portion of first joint furnished with short black hairs; second joint with a blunt tubercle on its inner dorso-lateral surface, just above the base of the finger forming part of the claw, and the apical portion of its outer lateral surface (behind the insertion of the thumb) prolonged into a tubercular process. Thumb with a prominent dorsal tubercle near its base. Palpi mottled; the outer ventro-lateral portion of the femur with an irregular row of long, slender, white tubercles, terminating with black spines; inner ventro-lateral surface with a series of long, black, curved, spinous hairs; inner lateral surface with similar shorter hairs more numerous, forming a brush on the slightly produced inner distal angle; dorsal and outer lateral surfaces with short spinous hairs; patella nearly as long as tibia, its inner distal angle produced and furnished with a brush of black hairs with recurved tips; shorter hairs in

distant rows on its dorsal and lateral surfaces; tibia with its inner lateral distal angle slightly swollen, not projecting forward as does that of the patella, but furnished with a similar brush of hairs; outer ventro-lateral surface with a subobsolete row of white tubercles, tipped with spinous hairs; dorsal and outer lateral surface furnished with sparse short hairs; tarsus thickly covered with long, black, recurved hairs, usually with a row of subobsolete, short, black tubercles on its inner ventro-lateral surface, and terminating in a moderately robust simple claw. Ventrum light grayish brown, hispid. Legs short, robust; coxæ light gray, covered with spinous hairs on elevated bases; trochanters light brown or grayish, tuberculate; remaining joints mottled with blackish brown and gray; all except tarsi with longitudinal rows of small black spines, and acute tubercles on their dorso-distal borders; tibiæ angular; tarsi hairy. Sheath of genital organ enlarged distally, truncate; shaft moderately robust, distally canaliculate, then expanded into a spoon-shaped portion, and terminating in a short, black, acute, articulated piece.

FEMALE.—Body larger and more robust; besides which it also differs from the male in having no tubercles on the mandibles. Apical joints of ovipositor grayish.

Ohio: Franklin County, Fulton County, August, 1890; Fairfield County, September 20, 1890.

Mitopus ohioensis Weed.

(Plate LXVIII.)

Oligolophus ohioensis. Weed, Amer. Nat., XXIV, 1103.

FEMALE.—Body, 6mm long, 3.5mm wide. Legs: first, 8mm; second, 20mm; third, 15mm; fourth, 10mm.

Dorsum of a peculiar glossy gray, central marking indistinct, shown mostly by stripes at outer margin; beginning at anterior lateral angles of cephalothorax two faint blackish stripes run obliquely back and toward the middle of the anterior border of the abdomen (forming a truncate V) and then run nearly parallel to each other two-thirds of the way to the posterior extremity, although they are nearly obsolete on the anterior third of the abdomen. Dorsum of cephalothorax free from tubercles except on margins, but having many minute brownish granules. Dorsum of abdomen with numerous, very minute pits scattered over its entire surface; and an indistinct transverse row of small whitish tubercles, tipped with very minute dark spines on each segment. Division between the cephalothorax and abdomen almost obsolete, and segmentation of anterior abdominal segments wholly so. Cephalic margin of cephalothorax nearly straight; lateral angles slightly produced, each having a small black spine; three prominent, acute, grayish tubercles on middle of anterior margin, each tipped with a minute black spine, the middle one being nearly twice as large as

those on the side, and also slightly in front of them. Eye eminence prominent, constricted at base; grayish, except a dark spot about each eye; eyes small; canaliculate, and having on each carina a row of four prominent, conical, grayish tubercles, each terminating in a minute black spine. Mandibles light brown, claws tipped with black; dorsal surface of second joint furnished with short black hairs. Palpi mottled; ventral surface of femur with numerous white, elongate, conical tubercles, each tipped with a prominent black spine; dorsal surface furnished with numerous black spinous hairs, many of which are tipped with white; patella short, with its inner lateral distal angle much prolonged (almost equaling the patella in length), the whole inner lateral surface being thickly set with strong spines, black tipped with white; a few smaller spines on its dorsal surface. Tibia slightly longer than patella, its inner lateral distal angle slightly prolonged, and its inner lateral surface provided with spines like those on the patella; its dorsal and outer lateral surfaces also having smaller and sparser spines, and its ventral surface being provided with a few whitish conical tubercles tipped with black spines; tarsus furnished with many rows of rather long black stiff hairs, and having two small black tubercles at the base of the well developed claw. Ventrum light gray, hispid. Legs very short, robust, pinkish; coxæ light gray with a slight pink tinge, provided with rather long, stiff black hairs on elevated, whitish bases; trochanters tuberculate, light gray with a pink tinge; remaining joints pinkish, all except tarsi having longitudinal rows of small black spines.

Described from one specimen collected in Warren County, Ohio, during the summer of 1889. I have since received from Prof. S. A. Forbes one other specimen taken in Illinois, which appears to belong to the same species.

A reëxamination of the type specimen after it has been in alcohol nearly four years shows that it was apparently just ready to moult when captured. The body has shrunken away from the outer skin, and an inner one seems to cover it. This leads to the suspicion that this is an immature form of *M. pictus*, the pink coloring possibly being due to the peculiar conditions of the moulting period.

Phalangium Linné.

Body soft or sub-coriaceous, with dorsum generally furnished with small sharp tubercles, which on the abdomen are arranged in transverse series. Eye eminence canaliculate, with two series of pointed tubercles. Lateral pores large, oval, and near the margin. Mandibles short and simple in the female, often more developed and provided with tubercles in the male; first article unarmed below. Palpi simple, often having the inner distal angle of the femur and of the patella very slightly produced, but never prolonged into a process; hairs equal, or sometimes thicker on the inner side, but not forming a brush; patella always shorter than tibia; maxillary lobe provided at the base with two conical

tubercles. Maxillary lobe of the second pair of legs much longer than wide, gradually narrowing from the base to the extremity, directed obliquely forward and not meeting; anterior border straight. Pectus large, parallel between the coxæ, rounded in front or slightly lanceolate, more rarely enlarged and obtusely truncate. Feet long, more or less robust. Claw of palpus simple.

But one species of this genus has been found in Ohio.

Phalangium cinereum Wood.

(Plate LXIX.)

Phalangium cinereum Wood, Comm. Essex Inst., VI, 25; Weed, Amer. Nat., XXVI, 32; Trans. Amer. Ent. Soc., XIX, 269.

MALE.—Body, 5–6.8^{mm} long; 3–4^{mm} wide; palpi, 4^{mm} long. Legs: first, 23–33^{mm}; second, 44–52^{mm}; third, 24–33^{mm}; fourth, 31–36^{mm}.

Dorsum ash-gray, sometimes more or less brownish, with a wide, vase-shaped central marking, which is sometimes obsolete. There is a transverse series of small spinose tubercles behind the eye eminence, another row on posterior border of cephalothorax, and one row on each abdominal segment except the last two; a curved series of similar tubercles is found in front of the eye eminence. These tubercles have whitish bases and acute black apices, and generally also have a spinose hair arising on one side near the apex of the white portion and reaching beyond the tip of the tubercle. In front of eye eminence there are two longitudinal series of three each of these tubercles. Lateral borders of cephalothorax subsinuate. Eye eminence low, canaliculate, with a series of five or six tubercles like those on dorsum on each carina. Mandibles brownish white, tips of claws black; second joint and apical portion of first joint furnished with short, black, stiff hairs. Palpi light brown, rather slender, first four joints with minute tubercles and short black hairs; none of the angles prolonged; tarsal joint without tubercles, but with hairs; claw moderately robust. Venter, including coxæ, light grayish brown, with many somewhat quadrangular patches of a more pronounced brown, and scattered blotches of chocolate-brown. Trochanters light brown, with many small tubercles; remaining joints of legs cinnamon-brown, more or less annulated with lighter and deeper shades; angular, with longitudinal rows of black spines; sheath of genital organ subcylindrical, truncate; shaft robust, with two lateral oval openings near distal extremity, then contracted into a blunt scoop-shaped piece, turned upward at nearly a right angle and terminating in a slender acute point.

FEMALE.—Body, 6–9^{mm} long, 4–5^{mm} wide; palpi, 4^{mm} long. Legs: first, 21–29^{mm}; second, 39–52^{mm}; third, 22–29^{mm}; fourth, 30–37^{mm}.

Differs from male as follows: Body larger, rounder. Dorsum darker gray, more mottled, central marking more distinct; tubercles on dorsum smaller, those on eye eminence more numerous, and those forming the longitudinal series in front of eye eminence also more numerous. Palpi

with hairs but without tubercles. Legs with annulations more distinct; trochanters without tubercles; spines on femur less prominent, and those on tibia obsolete; narrow quadrangular patches on venter of abdomen arranged in transverse series. Distal joints of ovipositor blackish; about thirty in number.

Ohio: Butler county, September 1, 1890; Delaware county, September 18, 1890; Erie county, July 5, 1890; Franklin county, October 4, 1890, September 18, 20, 21, 1889; October 18, 1889; Lawrence county, July, 1889; Madison county, July 21, 1890.

"The ash-gray harvest-spider passes the winter in the egg state. A few years ago in Illinois I found a bunch of about a dozen small, white, spherical eggs slightly beneath the soil surface, which were transferred to breeding cages. During the spring they hatched into small gray Phalangiids, which were believed to belong to the present species. I have never seen the female engaged in oviposition, but the structure of the ovipositor indicates that the eggs are deposited in the ground about half an inch below the surface. In the latitude of central Ohio there are apparently two broods each season, the first maturing late in June or early in July, and the second, which is much more numerous in individuals, in September.

"This species is preëminently what may be called an in-door form. It abounds especially in sheds, outhouses, and neglected board piles, being rarely found in the open field. Its color especially fits it for crawling over weather-beaten boards, making it inconspicuous against such a background. During the day it is usually quiet, but at dusk and on cloudy days it moves about quite rapidly. It probably feeds upon small flies and other insects that it finds during its nocturnal rambles. The only natural enemies I have seen it suffering from are the web-making spiders, in the webs of which it often perishes by getting its long legs inextricably entangled."*

Individuals of this species seem to be very irregular in becoming fully developed, and it is difficult to determine whether there is more than one generation a year or not.

EXPLANATION OF PLATES.

PLATE LVII.

Fig. 1. *Liobunum vittatum.* Male. Natural size.

2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

3. *Liobunum vittatum dorsatum.* Male from Dakota. Natural size.

PLATE LVIII.

Fig. 1. *Liobunum vittatum.* Female. Natural size.

2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

* Weed, American Naturalist, XXVI, 32.

PLATE LIX.

Fig. 1. *Liobunum nigropalpi*. Male. Natural size.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

PLATE LX.

Fig. 1. *Liobunum nigripes*. Male. Natural size.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

PLATE LXI.

Fig. 1. *Liobunum politum*. Male. Natural size.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, front view.

PLATE LXII.

Fig. 1. *Liobunum longipes*. Structural details of male, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.
2. *Mitopus pictus*. Structural detail of male, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view; *f*, tip of mandible; *g*, genital organ.

PLATE LXIII.

Fig. 1. *Liobunum ventricosum*. Male. Natural size.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view; *f*, maxillary lobes of second legs.

PLATE LXIV.

Fig. 1. *Liobunum bicolor*. Female. Natural size.
2. Structural details of same, magnified: *a*, body, with legs and palpi removed; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

PLATE LXV.

Fig. 1. Supposed immature male of *L. bicolor*.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

PLATE LXVI.

Fig 1. *Liobunum maculosum*. Female. Natural size.
2 Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus side view.

PLATE LXVII.

Fig 1. *Liobunum grande*. Male. Natural size.
2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view; *g*, maxillary lobe of second leg.

PLATE LXVIII.

Fig. 1. *Mitopus ohioensis.* Female. Natural size.

2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *c*, eye-eminence, front view; *d*, palpus, side view; *e*, claw of palpus, side view.

PLATE LXIX.

Fig. 1. *Phalangium cinereum.* Male. Natural size.

2. Structural details of same, magnified: *a*, body; *b*, eye-eminence, side view; *d*, palpus, side view; *e*, claw of palpus, side view; *f*, maxillary lobe of second leg; *h*, tip of ovipositor; *i*, dorsal tubercle.

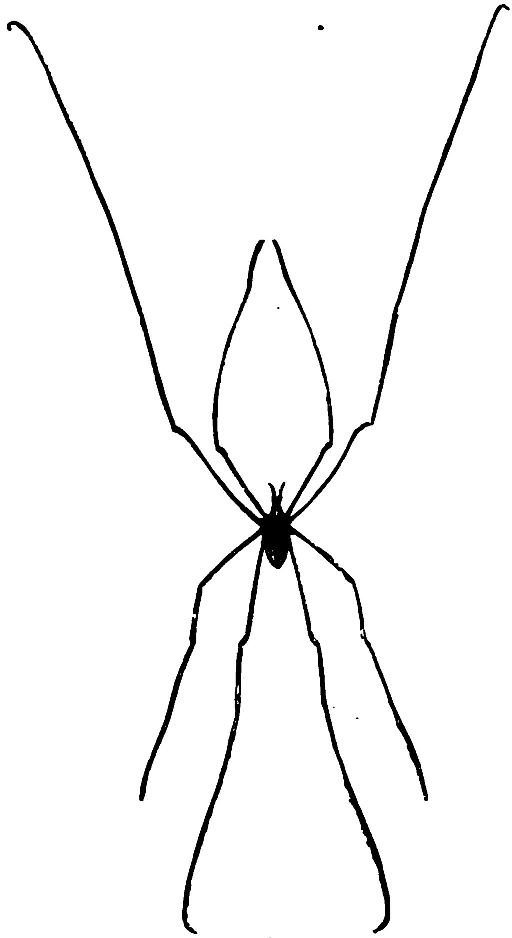


Fig. 1.

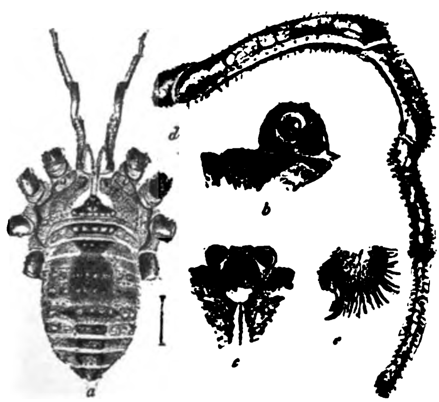


Fig. 2.

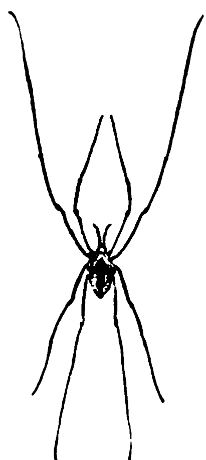
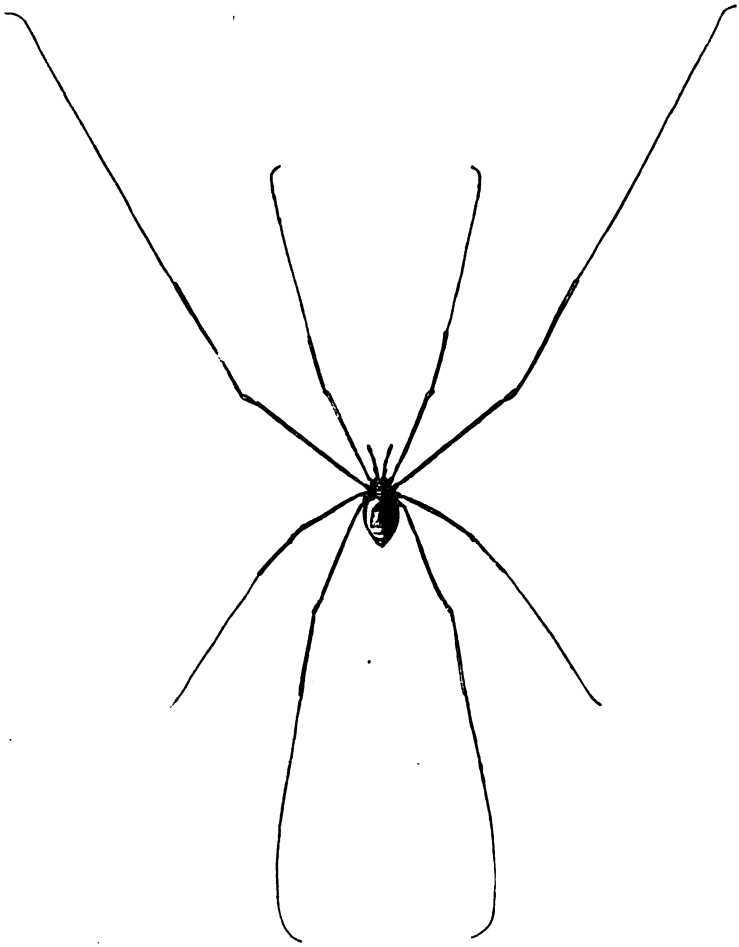


Fig. 3.

Liobunum vittatum (Say). Male.



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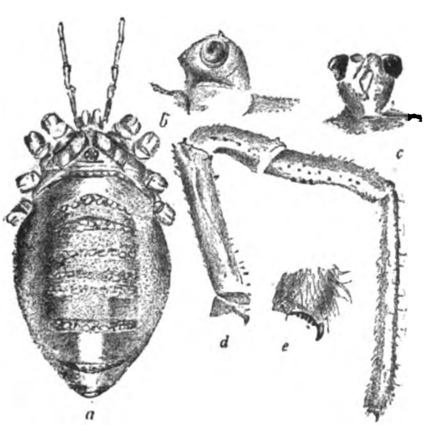
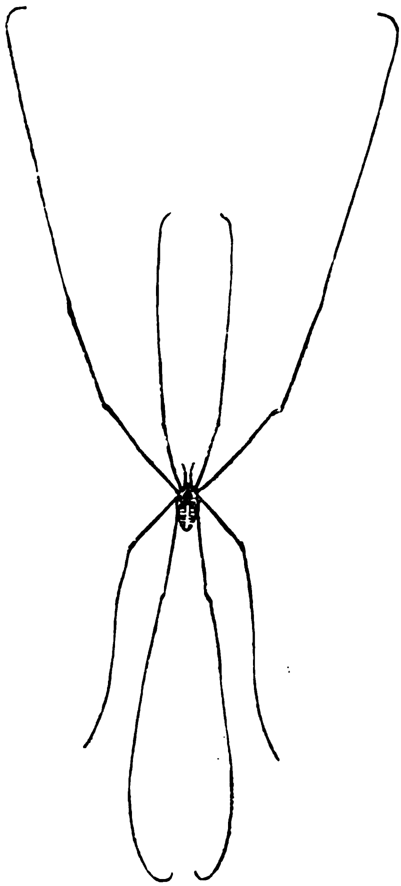


Fig. 2.

Liobunum vittatum (Say). Female.



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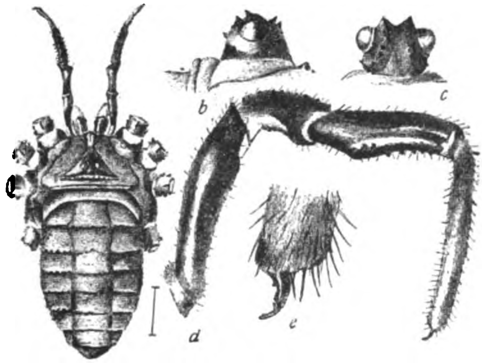
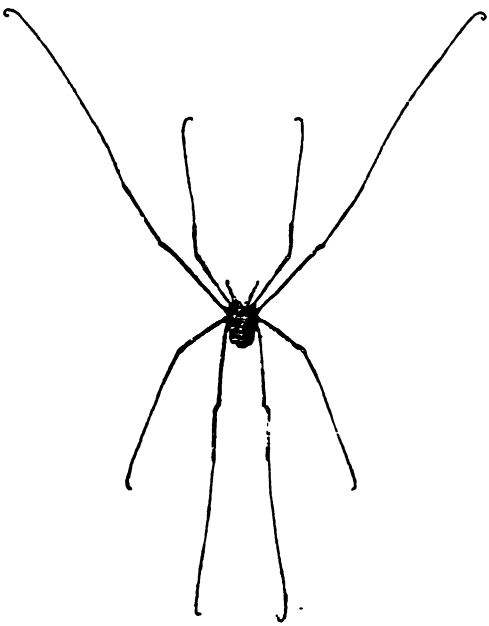


Fig. 2.

Liobunum nigropalpi (Wood). Male.



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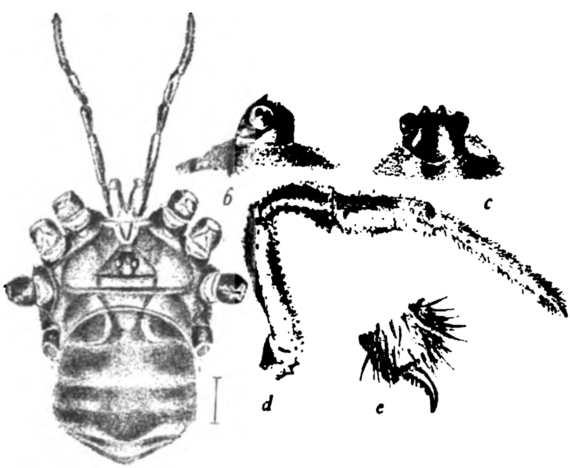
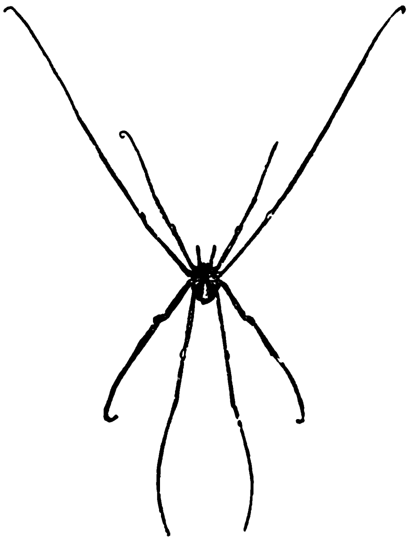


Fig. 2.

Liobunum nigripes Weed. Male.



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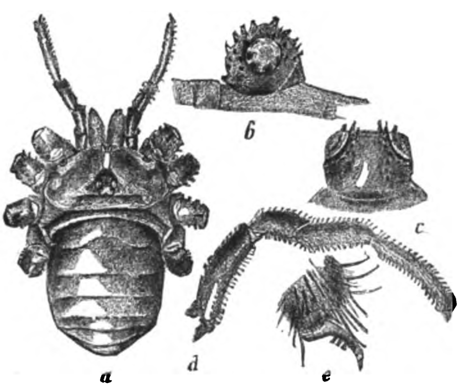
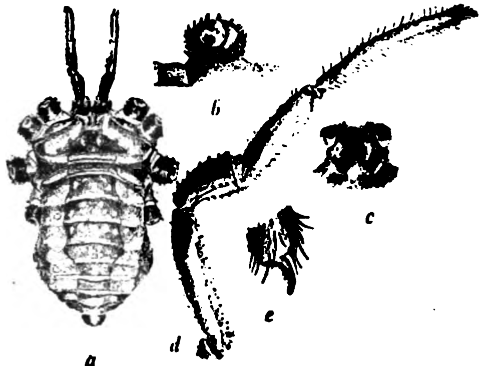


Fig. 2.

Liobunum politum Weed.



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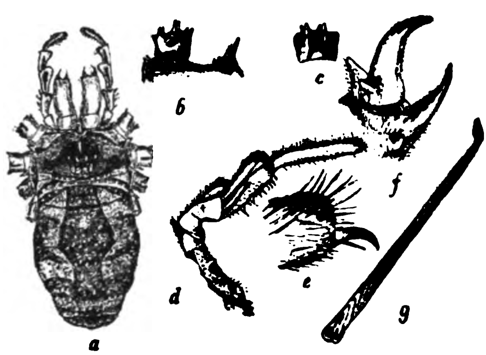


Fig. 2.

1. *Liobunum longipes.* 2. *Mitopus pictus.*

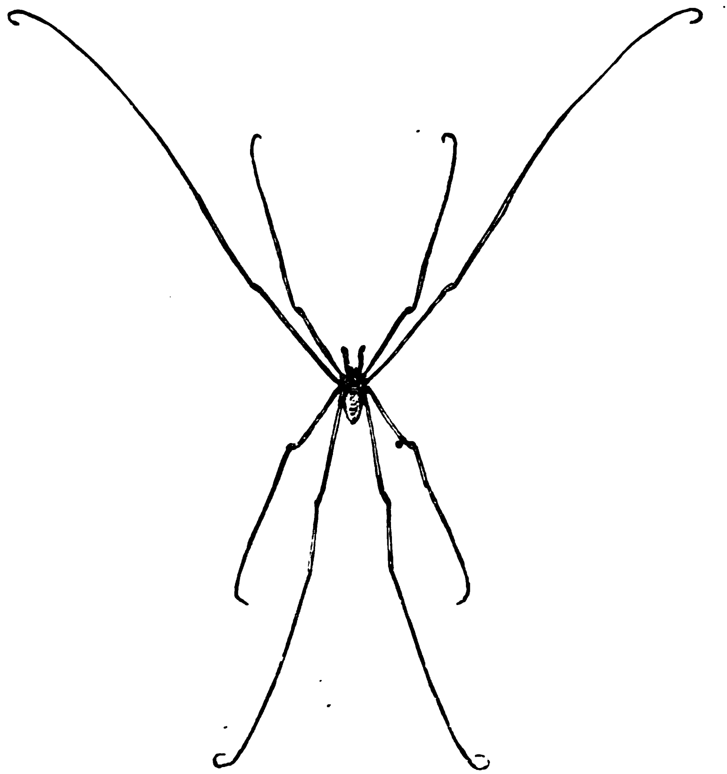


Fig. 1.

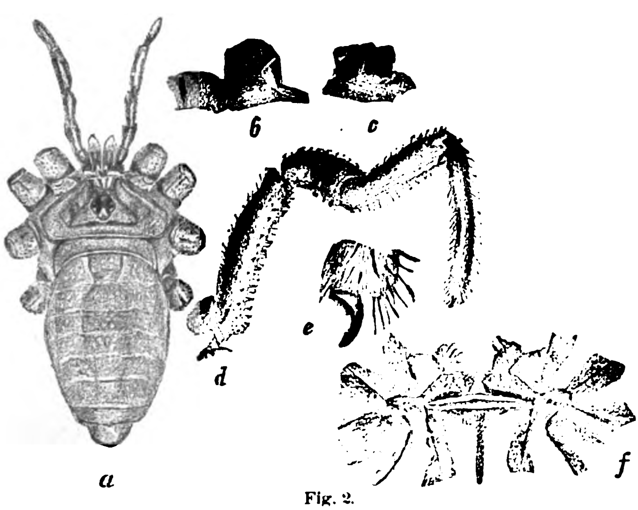


Fig. 2.

Liobunum ventricosum (Wood).

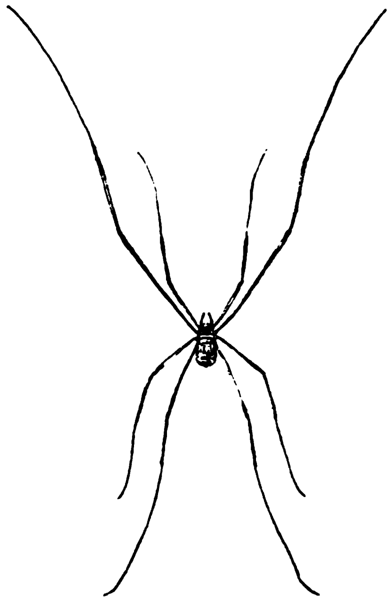


Fig. 1.

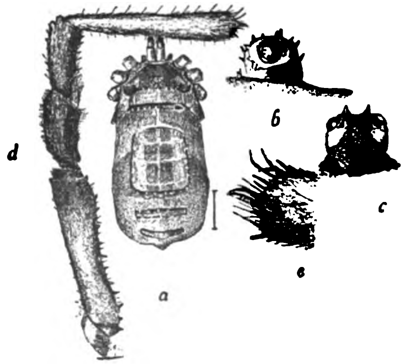
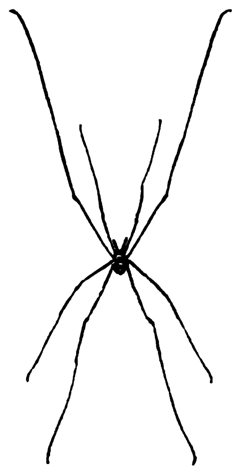


Fig. 2.

Liobunum bicolor (Wood).



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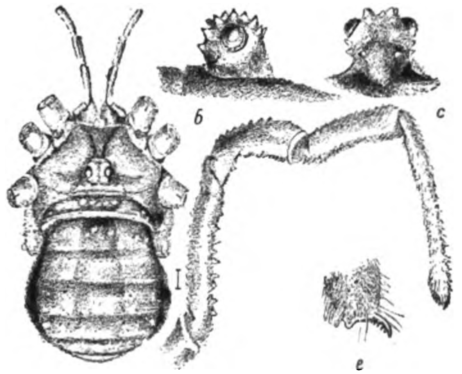
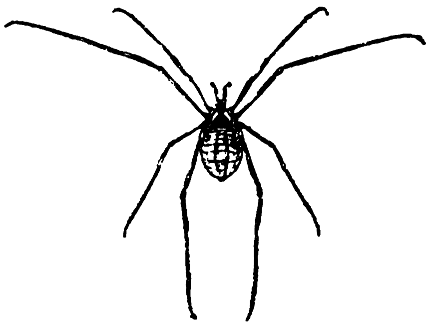


Fig. 2.

Liobunum bicolor (Wood). Immature male.



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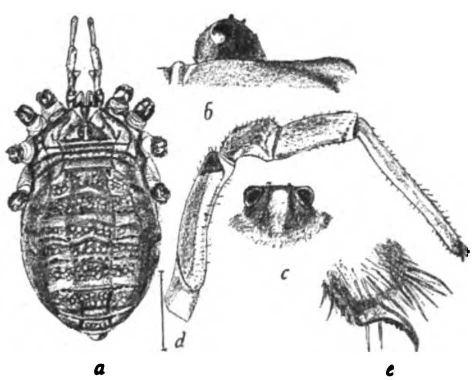
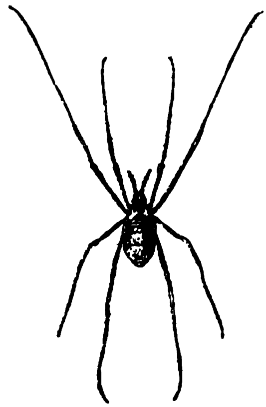


Fig. 2.

Liobunum maculosum (Wood).



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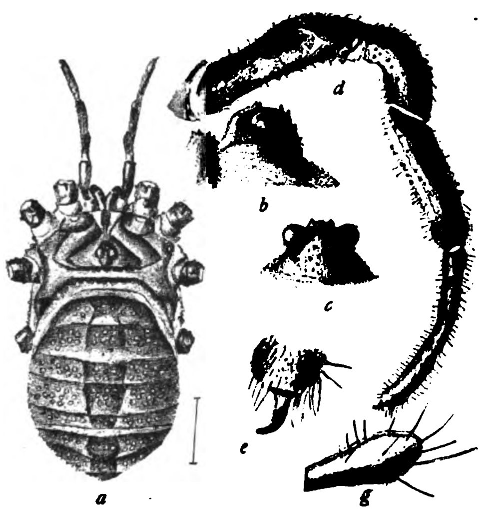
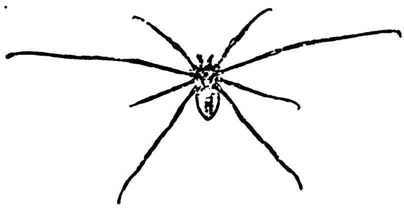


Fig. 2.

Liobunum grande (Say).



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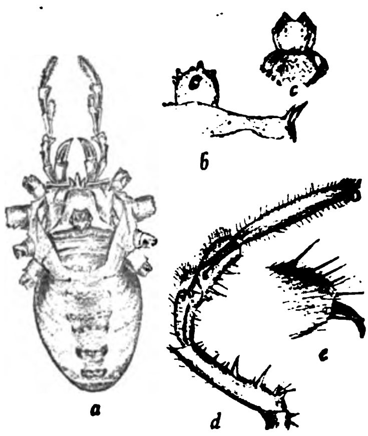
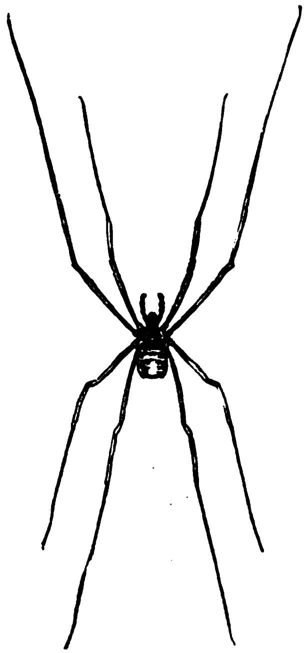


Fig. 2.

Mitopus ohioensis Weed.



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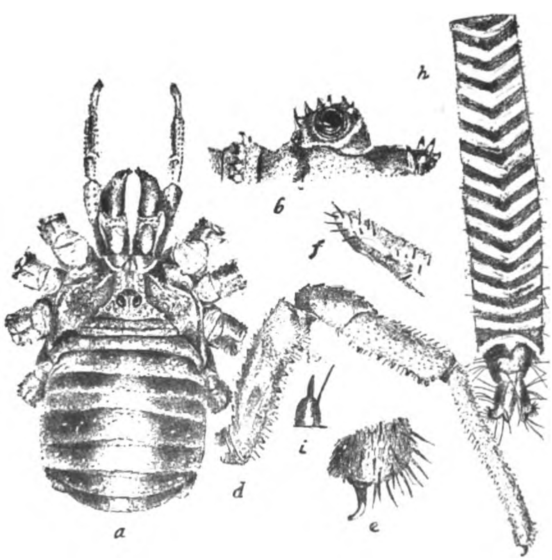

Fig. 2.

Phalangium cinereum Wood.

SCIENTIFIC RESULTS OF THE U. S. ECLIPSE EXPEDITION TO WEST AFRICA, 1889–'90.

REPORT UPON THE INSECTA, ARACHNIDA, AND MYRIOPODA.

BY

C. V. RILEY,

Honorary Curator of Insects,

[*including descriptive papers on Pseudoneuroptera by P. P. Calvert; and on Arachnida by Nathan Banks and George Marx.*]

(With Plate LXX.)

INTRODUCTION.

The insects of this collection are from a region the insect fauna of which is almost totally unrepresented in the National Museum collection. For want of funds we have been unable to make more than a very small beginning in the collection of exotic insects, while the literature at command in Washington upon exotic species, is yet very insufficient. A large proportion also of the African insect fauna yet remains to be worked up. For these various reasons I have been obliged to refer much of the material to specialists for determination, my own part in the work being little more than the orderly arrangement of the determinations for publication. The collection as a whole is not large, and the Coleoptera and Lepidoptera were more generally collected than the insects of any other order.

The Hymenoptera of the collection were kindly determined by Mr. W. F. Kirby, of the British Museum, and I have simply brought the list together in proper arrangement and added a few notes.

The Lepidoptera, after some few species had been determined at the Museum, were sent to Rev. W. J. Holland, of Pittsburg, Pa., who submitted a full list of determinations arranged according to locality. In the interest of uniformity Mr. Holland's list has been rearranged in systematic order.

There were only seven species of Diptera collected. Dr. S. W. Williston, who has so materially assisted me in working on the Diptera, was unwilling to attempt their determination, and the material was so poor and so scanty that it was not thought worth while to send it abroad. Four of the species have been determined generically.

In the Coleoptera, with the aid of Mr. M. L. Linell, a certain number of species were made out and the residue were then sent to Dr. David Sharp, of England, who has determined them, when necessary, by comparison with the collection in the British Museum. Mr. Champion, of the British Museum, has given a few of the names in the families Cistelidæ, Lagriidæ, and Anthicidæ to Dr. Sharp, while Mr. Jacoby has examined some of the Chrysomelidæ and Mr. Gorham the Endomychidæ.

The Orthoptera have been determined by Mr. Henri de Saussure, of Geneva, Switzerland.

The Pseudoneuroptera were sent to Mr. P. P. Calvert, of Philadelphia, Pa., who describes the new species.

The Hemiptera were sent to Mr. A. L. Montandon, of Bucharest, Roumania, who has given me most of the determinations.

In the Arachnida the families Attidæ and Lycosidæ have been studied by my assistant, Mr. Nathan Banks, and his report, with descriptions of the new species, is appended. The remaining Arachnids have been referred to Dr. George Marx, whose report, with descriptions, is also included. The Myriopoda were sent to Messrs. O. F. Cook and G. N. Collins, of Syracuse University, and as five of the seven species comprising this material were, according to their decision, entirely new to science, I have appended their report in the form in which it was received.*

I have added such details as to number of specimens and locality as may have value. My sincere thanks are due to all the gentlemen named for their courteous aid in the determination of the material.

INSECTA.

Order HYMENOPTERA.

Family APIDÆ.

Bombus sp.

A single poor alcoholic specimen. Horta, Fayal.

Xylocopa torrida Westwood.

Eight specimens, all females. Congo, January 2, 1890, and December 20, 1889.

Megachile rufipes Fabr.

One poor specimen. Congo, January 2, 1890.

Megachile nasalis Smith.

One poor specimen. Congo, December 25, 1889.

*On account of the excessive delay in publication, Messrs. Cook and Collins withdrew their report in January, 1893, and have published it elsewhere.

Family VESPIDÆ.

Polistes smithii Sauss. Var. (?)

Two specimens. Congo, January 2, 1890.

Belenogaster sp.

One specimen. Congo, December 27, 1889.

Family EUMENIDÆ.

Synagris calfida Linn.

Two specimens. Congo, December 24, 1889.

Synagris æquatorialis Sauss.

Two specimens. Congo, no date.

Eumenes fenestralis Sauss.

One specimen. Congo, no date.

Eumenes æthiopica Sauss, var. (?)

One specimen. Congo, January 2, 1890.

Family LARRIDÆ.

Larra sericea Smith.

One specimen. Congo, January 2, 1890.

Larra sp.

One specimen. Congo. This is a handsome species, one-half larger than *L. sericea*, with a golden pubescence on the thorax, the wings yellowish and the abdomen black, transversely banded with silvery pubescence on the posterior borders of the segments. The face is densely clothed with golden pubescence, and the legs are uniformly light brown.

Family SPHECIDÆ.

Pelopæus spirifex L.

Two specimens. Congo, January 2, 1890. The clay tunnels of this species were also collected, but present nothing characteristic.

Pelopæus eckstelnii Dahlt. (?)

Two specimens. Congo. This species, which Mr. Kirby has labeled with a query, is rather larger than *P. spirifex*, and differs superficially, mainly in being red where the latter is yellow.

Sphex sp.

One specimen. Congo. This is a large and handsome species, 40 millimeters in length, with blue-black abdomen and wings, velvety, black metathorax, and mahogany-brown pro and meso thorax, head antennæ, and legs.

Family POMPILIDÆ.

Mygnimica atropos Smith.

One specimen. Congo, December 30, 1889.

Family MUTILLIDÆ.

Mutilla leucopyga Smith.

One specimen. St. Paul de Loanda.

Mutilla medon Smith.

Two specimens. Congo.

Mutilla sp.

One specimen. Congo. This is a small wingless insect, two-thirds the size of *M. leucopyga*, which it resembles in general coloration. The abdomen, however, is less hairy, is of an elongate pyriform shape, and has three silvery spots each side.

Family PONERIDÆ.

Streblognathus æthiopicus Smith.

One specimen. Freetown, Sierra Leone.

Family FORMICIDÆ.

Catoglyphis viatica Fabr.

One specimen. Congo.

Catoglyphis viatica Fabr., var. (?)

One specimen. Congo.

Camponotus fulvipectus De Geer.

Three specimens of this handsome species. South Africa.

Family CHRYSIDIDÆ.

Pyria lyneca Fabr.

One specimen. Congo.

Family PROCTOTRYPIDÆ.

Embolemus (?) sp.

One specimen. Congo.

NOTE.—In addition to the recognizable material, there was a mutilated Andrenid, an undeterminable Melinid, and a pupa apparently of a large Eumenid, all from Congo.

Order LEPIDOPTERA.

Suborder RHOPALOCERA.

Family PAPILIONIDÆ.

Papilio demoleus Linn.

One torn male, Freetown, and two specimens, Congo (Banana Point).

Family PIERIDÆ.

Terias æthiopica Triu.

Several examples, Freetown, and several specimens, Congo (Banana Point).

Terias desjardinsii Boisd.

Two females. Elmina.

Terias senegalensis Boisd.

Two or three specimens. Congo (Banana Point).

Pieris severina Cram. (?)

The tattered fragments of a species of *Pieris*, probably *severina*, collected at Cape Verde Islands (St. Vincent). The principal reason for calling this identification into question is the fact that the anterior wing lacks the black spot at the end of the cell. Otherwise, so far as can be determined from the fragments of the insect preserved for us by the diligence of the collector, there is reason to think that the foregoing determination is correct. Two undoubted examples were collected at Banana Point, Congo.

Pieris gidica Godt.

Several males and one female. Congo (Banana Point). The specimens are rather larger than, and the black markings heavier than, in any examples I have seen from Natal and more southerly portions of the continent, and upon the under side of the primaries the black angulated streak at the extremity of the discoidal cell is extended inwardly along the median nervure to the origin of the first median nervule. This is a constant feature in every specimen, and gives the under side a very different facies from typical specimens of *gidica* taken further south. The form is worthy of a varietal name.

Pieris zochalia Boisd.

A fragment of a male specimen. Congo (Banana Point).

Herpæmia eriphia Godt.

One female. St. Paul de Loanda.

Mylothris poppea Cram

One ragged female. Freetown.

Mylothris chloris Fabr.

One female. Elmina.

Colias electra Linn.

One example. Cape of Good Hope.

Teracolus evippe Linn.

One badly damaged specimen of the male of the species, St. Vincent, Cape Verde Islands. Also two males and one female, St. Paul de Loanda.

Teracolus calias Cram.

One mutilated female, St. Vincent, Cape Verde Islands. Also one male, St. Paul de Loanda.

Teracolus doubledayi Hopper, = *T. hewitsonii* Kirby.

Two examples. St. Paul de Loanda.

Family DANAIDÆ.

Danais plexippus Linn.*

Danais chrysippus Linn.

Numerous examples, all males, Congo (Banana Point). Also two males, St. Helena.

Danais chrysippus Linn var. *alcippus* Cram.

One specimen of this, the common North African form of the species, Freetown.

Family ACRÆIDÆ.

Acræa encedon Linn.

Numerous examples, male and female Congo (Banana Point).

Acræa manjaca Boisd.

One female example, St. Paul de Loanda, differing from Madagascar specimens only in being a trifle larger.

Acræa horta Linn.

Numerous examples, Cape of Good Hope.

Family NYMPHALIDÆ.

Pyrameis cardui Linn.

Four examples, St. Helena.

Precis amestris Drury.

One example Freetown, and one good example, Elmina.

Hypolimnas misippus Linn.

One male of this widely distributed species was taken at Porto Grande, St. Vincent, Cape Verde Islands, one female at Congo (Banana Point), and three males and three females at St. Paul de Loanda.

Neptis melicerta Drury.

A small example of the male, Freetown.

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* There are two female sepecimens of this insect in this collection, which were taken by Mr. E. G. Howe at Horta, Fayal, Azores Islands. The insect is North American originally, but within comparatively recent years has attained to a wide geographical distribution. Its spread westwardly through the islands of the Pacific and to Australia has recently been commented upon by entomologists, and I have a specimen taken in Java about three years ago by Mr. William Doherty. Its presence in the Azores is in keeping with its occasional occurrence in England, and we may soon expect to find it established upon the continent of Africa, where it will no doubt find congenial food plants.—W. J. H.

Euphædra cyparissa Cram.

The remnants of a specimen, the hind wings of which appear to have been bitten off by a bird or a dragon fly, Freetown.

Hamanumida dædalus Fabr.

A piece of a specimen, Freetown.

Palla varanes Cram.

A perfect female, Freetown.

Harma cænis Drury.

One male specimen, St. Paul de Loanda.

Family SATYRIDÆ.

Mycalesis vulgaris Butl.

One male specimen, Freetown. This species is widely distributed from Senegambia southward into the region of the Congo.

Mycalesis eliasis Hew.

Three specimens, St. Paul de Loanda.

Family LYCÆNIDÆ.

Lycæna lysimon Huebn.

One female, St. Paul de Loanda, and one female captured on board ship between St. Vincent and Sierra Leone.*

Lycæna bætica Linn.

Two examples, St. Helena, and one male specimen, Ascension.

Family HESPERIDÆ.

Tagiades flesus Fabr.

One specimen, Freetown, and one specimen, Elmina.

Pamphila mohopaani Wallengren.

One female example, Congo (Banana Point).

Pamphila n. sp.?

St. Paul de Loanda.

One specimen, in poor condition, which I can not refer satisfactorily to any of the species known to me, but which comes very near *P. fatuellus* Hopffer, from which it differs mainly by having two spots at the end of the cell of the anterior wing; in this respect being like *P. mohopaani*, though otherwise, especially upon the under side, revealing great differences.

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*It is quite a common occurrence for specimens of Lepidoptera and other winged insects to be taken at sea off the western coast of Africa, and numerous references to such phenomena are found in the literature of travel. The writer has in his possession some specimens of *Lycæna cissus* Godt., and of the common *Pieris rapæ* Linn., which were taken at sea 75 miles off Cape Palmas. The power of sustained flight of such insignificant and apparently weak creatures is simply marvelous.—W. J. H.

Suborder HETEROCERA.

Family SPHINGIDÆ.

Sphinx cingulata Linn.

Three specimens, St. Vincent, Cape Verde Islands.

Family ZYGÆNIDÆ.

Ægocera venulia Cram.

One male example of the varietal form figured by Boisduval in the Monographie des Zygamides Planche I, Fig. 3.

Euchromia sperchina Cram.

Two specimens, Freetown.

Euchromia leonis Butl.

One specimen, Freetown.

Syntomis sp.

Two examples, too badly rubbed to make a positive determination possible, Freetown.

Syntomis kuhlweinii Lefeb.

Two specimens, Cape of Good Hope.

Family BOMBYCIDÆ.

Bombycid moth not determined, Freetown.

Family NOCTUIDÆ.

Achæa chameleon Guen.

Two examples, Congo (Banana Point), and one example, St. Paul de Loanda.

Eustrotia? sp.?

One broken specimen, Congo (Banana Point).

Tarache? sp.?

Two examples, Congo (Banana Point).

Order DIPTERA.

Family ASILIDÆ.

Omnatius n. sp.

Two specimens, Congo, January 2, 1890.

Ospriocerus sp.?

One specimen, Congo.

Family TABANIDÆ.

Diachlorus sp.

One specimen, Congo, January 2, 1890.

Family DOLICHOPODIDÆ.

Gen. ? sp. ?

One specimen, Freetown, Sierra Leone.

Family CONOPIDÆ.

Conops sp.

One specimen, Congo.

Family MUSCIDÆ (sens. strict.)

Gen. ? sp. ?

Two specimens, Congo.

Family HIPPOBOSCIDÆ.

Gen. ? sp. ?

One specimen, Congo, January 2, 1890.

Order COLEOPTERA.

Family CICINDELIDÆ.

Cicindela melancholica Fab. (Determined by Dr. David Sharp.)

Eleven specimens, St. Paul de Loanda.

Family CARABIDÆ.

Calosoma rugosum De Geer.

One specimen, Porto Grande, St. Vincent, November 11, 1889.

Scarites perplexus Dej. (Determined by Sharp).

One specimen, Congo.

Graphipterus limbatus Cast. (Determined by Sharp.)

One specimen, South Africa.

Anthia decemguttata Linn.

One specimen, Cape of Good Hope.

Pheropsophus guineensis Chand.

Three specimens, Congo.

Abacetus sp. (Sharp det.)

One specimen, Congo.

Chlænius sp.

"Probably var. *major* of *C. cuprithorax* Qued." (Sharp). One specimen, Congo.

Harpalus ruficornis Fab. (Sharp det.)

One specimen, Port Horta, Fayal, November 2, 1889.

Family DYTISCIDÆ.

Eretes sticticus Linn.

Five specimens, St. Paul de Loanda, (?) December 12, 1889.

Cybister filicornis Sharp.

Six specimens, Congo, December 25, 1889.

Cybister senegalensis Aubé.

Two specimens, Congo, December 25, 1889.

Cybister tripunctatus Oliv.

Thirty-one specimens, St. Paul de Loanda (?), December 12, 1889.

Family HYDROPHILIDÆ.

Berosus cuspidatus Er.

One specimen, Congo.

Family GYRINIDÆ.

Dineutes aereus Klug.

One specimen, Freetown, Sierra Leone.

Dineutes subspinosus Klug.

One specimen, St. Paul de Loanda.

Family STAPHYLINIDÆ.

Goërius oleus Müll.

Two specimens, Port Horta, Fayal.

Family SCARABÆIDÆ.

Ateuchus prodigiosus Er. (Sharp det.)

One specimen, St. Paul de Loanda.

Ateuchus capensis Dej. (Sharp det.)

Three specimens, Congo, and one specimen, South Africa.

Gymnopleurus chloris Klug. (Sharp det.)

Three specimens, Congo.

Gymnopleurus virens Er.

Fourteen specimens, St. Paul de Loanda; one specimen, Congo.

Onthophagus hybridus Dej. (**vinctus** Er.) (Sharp det.)

One specimen, Congo.

Onthophagus thoracicus Oliv. var. of ♀. (Sharp det.)

Three specimens, Congo, January 2, 1890.

Anomala sp. "Unnamed in our collections." (Sharp).

One specimen, Congo.

Adoretus sp. "Unknown." (Sharp).

Two specimens, Congo.

Adoreuts sp. "Unknown" (Sharp).

Two specimens, Congo, January 2, 1890.

Melisseus eudoxus Woll. (Sharp det.

One specimen, St. Helena, March 1, 1890.

Heteronychus sp. "Unknown, near *licas, arator*." (Sharp).

Sixteen specimens, Congo, December 25, 1889.

Temnorhynchus diana Beauv.

One specimen, Congo.

Oryctes boas Fabr.

One male, Elmina, Gold Coast, November 28, 1889, and one female, St. Paul de Loanda.

Heterorhina monoceros Gory and Perch.

Two specimens, St. Paul de Loanda.

Gnathocera trivittata Swed. (Sharp det.)

Five specimens, Freetown, Sierra Leone.

Gnathocera afzelii Swartz. (Sharp det.).

Eight specimens, Freetown, Sierra Leone.

Pachnoda inscripta Gory and Percheron.

Four specimens, Freetown.

Pachnoda marginata Dru.

Four specimens, Elmina, Gold Coast, and twelve specimens, Freetown, Sierra Leone.

Family BUPRESTIDÆ.

Aphanisticus sp. "Unknown" (Sharp).

One specimen, Congo.

Family MONOMMIDÆ.

Monomma giganteum Guer. (Sharp det.).

One specimen, St. Paul de Loanda.

Family ELATERIDÆ.

Heteroderes "near **crucifer**. ? **inscriptus** Er., but has not been compared with description" (Sharp).

One specimen, Congo.

Family PTINIDÆ.

Apate terebrans Pall. (Sharp det.).

Two specimens, Congo.

Family TENEBRIONIDÆ.

Zophosis muricata Fab. (Sharp det.).

One specimen, South Africa.

Pedinomus favosus Er. (Sharp det.).

One specimen, South (?) Africa.

Psammodes tenebrosus Er. (Sharp det.).

Twelve specimens, St. Paul de Loanda.

Blaps nitens Cast. ? (Sharp det.).

One specimen, Horta, Fayal, November 2, 1889.

?**Blaps**. "Unknown" (Sharp).

One specimen, Horta, Fayal, November 2, 1889.

Adesmia sp. "Unknown to me and at British Museum" (Sharp).

One specimen, South Africa.

Pogonobasis verrucosa Er. (Sharp det.).

One specimen, Congo.

Opatrum sp. ? (Sharp det.).

Seven specimens, St. Helena.

Gnophota curta Er. var. (Sharp det.).

Three specimens, St. Paul de Loanda.

Gnophota curta Er. ? another var. (Sharp det.).

One specimen, Congo, December 25, 1889.

Zophobas morio Fab. (Sharp det.).

Three specimens, St. Helena, February 22, 1890.

Family CISTELIDÆ.

Hymenorus sp. (Champion det.).

Two specimens, Congo, January 2, 1890.

Family LAGRIIDÆ.

Lagria aeneipennis Fabr. ? (Sharp det.).

Three specimens, Congo.

Lagria sp. near **cuprina** Fabr. (Champion det.).

One specimen, Freetown, Sierra Leone.

Family ANTHICIDÆ.

Formicomus sp. (Champion det.).

One specimen, Congo.

Family RHIPIDOPHORIDÆ.

Emenadia flabellata Fab. (Sharp det.).

One specimen, Congo, January 2, 1890.

Family MELOIDÆ.

Mylabris oculata Thunb. (Sharp det.).

Two specimens, South (?) Africa.

Mylabris dentata Oliv. (Sharp det.).

Two specimens, St. Paul de Loanda; five specimens, Congo.

Mylabris (Actenodia) chrysomelina Er. (Sharp det.).

Two specimens, St. Paul de Loanda.

Family OTIORHYNCHIDÆ.

Tanymecus sp. ? (Sharp det.).

One specimen, Congo.

Tanymecus sp. ? (Sharp det.).

Two specimens, Congo. "Genus unknown to me and not in the British Museum; near *Otiorhynchus*" (Sharp). Two specimens, Cape Ledo.

Naupactus longimanus Fab. (Sharp det.).

Five specimens, Ascension Island. This is a Brazilian species, and its occurrence at Ascension Island is of interest.

Family CERAMBYCIDÆ.

Delochilus prionoides Thoms. (Sharp det.).

One specimen, Cape of Good Hope.

"Genus near *Oeme*; unknown to Bates or me; not in British Museum; not compared with Quedenfeldt's recent descriptions. This is the most important insect of the lot" (Sharp). One specimen, Congo, January 2, 1890. This is a handsome, slender, burnished green species, with rufous legs, 25 millimeters long.

Phryneta spinator Fab.

One specimen, Congo, January 2, 1890.

Diastocera trifasciata Fab. (Sharp det.).

Eight specimens, Freetown, Sierre Leone.

Family CHRYSOMELIDÆ.

Cryptocephalus sp. "unknown" (Sharp).

Two specimens, Congo, January 2, 1890.

? **Melitonoma** (Sharp det.).

One specimen, Congo, January 2, 1890.

? **Melitonoma** (Sharp det.).

Seven specimens, Congo, January 2, 1890. One specimen, St. Paul de Loanda.

Aulacophora sp. ? (Jacoby det.).

Two specimens, Congo, January 2, 1890.

Luperodes occipitalis Reiche ? (Jacoby det.).

Sixteen specimens, Congo, January 2, 1890.

Graptodera sp. (Sharp det.).

Five specimens, Congo.

Family ENDOMYCHIDÆ.

Danaë (Oediarthrus Gerst.) **natalensis** Gorh. (Gorham det.).

One specimen, Congo.

Family COCCINELLIDÆ.

Xanthadalia Cr. (**Harmonia** Muls.) **rufescens** Muls. var. (Sharp det.).

Five specimens, Congo.

Alesia (**Micraspis** Cr.) **aurora** Gerst. ? (Sharp det.).

Five specimens, Congo, January 2, 1890.

Exochomus nigromaculatus Goeze (**auritus** Scriba) (Sharp det.).

Nine specimens, Congo, January 2, 1890.

Chilomenes (**Cydonia** Muls.) **lunata** Fabr. (Sharp det.).

Five specimens, Congo, January 2, 1890.

Chilomenes lunata Fabr. var. (Sharp det.).

Seven specimens, Congo; one specimen, St. Helena, a dark variety, in which the yellow and red maculation has become reddish brown.

Epilachna chrysomelina Fabr. (Sharp det.).

Three specimens, Congo.

Order HEMIPTERA.

Suborder HETEROPTERA.

Family PENTATOMIDÆ.

Agonoscelis erosa Wolff.

Two specimens, Congo.

Nezara viridula Linn.

One specimen, Horta, Fayal, November 2, 1889.

Family COREIDÆ.

Leptoglossus membranaceus Fabr.

One specimen, Congo, January 2, 1890.

Family LYGÆIDÆ.

Lygæus elegans Wolff.

Two specimens, South Africa.

Family PYRRHOCORIDÆ.

Odontopus sexpunctatus Lap.

Two specimens, St. Paul de Loanda.

Dysdercus superstitiosus Fabr.

Two specimens, Congo, January 2, 1890.

Family REDUVIIDÆ.

Harpactor segmentarius Germ.

Two specimens, Congo, January 2, 1890.

Harpactor albopilosus Sign.

Two specimens, Congo.

Family HYDROMETRIDÆ.

Lampotrechus leptocorus Reuter.

Two specimens, Congo.

Family NEPIDÆ.

Laccotrephes fabricii Stål.

One specimen, Congo, December 25, 1889.

Family BELOSTOMATIDÆ.

Belostoma niloticum Stål.

One specimen, St. Paul de Loanda.

Order ORTHOPTERA.

Family BLATTIDÆ.

Panchlora indica Fabr.

Six specimens, St. Helena.

Panchlora maderæ Fabr.

One specimen, St. Helena; one specimen, Ascension Island, March 22, 1890.

Blatta germanica L.

One specimen, Congo, January 2, 1890.

Periplaneta australasiæ L.

One specimen, Porto Grande, November 11, 1889; three specimens, Barbadoes, May 8, 1890.

Nauphoeta cinerea Oliv.

Two specimens, St. Helena.

Family MANTIDÆ.

Polyspilota pustulata Fabr.

One specimen, Freetown, Sierra Leone.

Parathespis sp. (larva).

One specimen, St. Paul de Loanda.

Thespis sp. (larva).

One specimen, St. Paul de Loanda.

Mantis? sp. (larva).

One specimen, Freetown, Sierra Leone.

Family PHASMATIDÆ.

Bacillus sp.?

One specimen, Congo.

Family GRYLLIDÆ.

Liogryllus bimaculatus De Geer.

Six females and larvæ. From Ascension Island and St. Helena, February 23, 1890.

Gryllus melanocephalus Serv.

One specimen, Congo.

Œcanthus capensis Sauss.

One specimen, Freetown, Sierra Leone.

Gryllotalpa africana Palis d. Beauv.

One specimen, Congo, January 2, 1890.

Gryllomorpha aptera Herr.-Schäf.

One specimen, Ascension Island.

Brachytrypus vastator Afz. ♂ ♀ and larvæ.

Five specimens, December 25, 1889.

Family CONOCEPHALIDÆ.

Gen.? sp.? larvæ.

Two specimens, Ascension Island.

Superfamily ACRIDIINA.

Family ACRIDIIDÆ.

Acridium anguliferum Kraus.

One specimen, Freetown, Sierra Leone.

Near Pezotettix. sp ?

One specimen, Freetown, Sierra Leone.

Coptacra sp.? (larva).

One specimen, Congo.

Catantops ? (larva).

One specimen, Congo.

Catantops sp.

One specimen, Congo.

Catantops melanostictus Schaum.

One specimen, Congo, January 2, 1890.

Caloptenus femoratus Fabr.

One specimen, St. Paul de Loanda, December 10, 1889.

Family ŒDIPODIDÆ.

Pachytylus (larvæ).

Two specimens, St. Paul de Loanda.

Cosmorhyssa costata Fabr.

Two specimens, Congo.

Acrotylus deustus Thunbg. var.

One specimen, St. Paul de Loanda.

Trilophidia annulata Thunbg.

One specimen, Congo.

Pachytylus migratorioides Reich.

Small variety. One larva, Horta, Fayal; two adults, Ascension Island.

Œdaleus nigrofasciatus Fabr. var. **gracilis** Sauss.

Three specimens, Porto Grande.

Family PYRGOMORPHIDÆ.

Chrotogonus senegalensis ♂ ♀.

One specimen, St. Paul de Loanda; two specimens, Congo.

Ochrolebia caffra ? Linn. (larvæ).

Eight specimens, Congo, January 2, 1890.

Atractomorpha congensis Sauss. ♂ ♀.

Eleven specimens, Congo.

Family PAMPHAGIDÆ.

Xiphocera canescens St.

One specimen, Congo.

Family TETTIGIDÆ.

Paratettix sp.

Seven specimens, Congo.

Gen. ? **sp.** ? (larvæ).

Congo.

Family TRYXALIDÆ.

Acrida unguiculata Ramb.

Thirteen specimens, Congo and St. Paul de Loanda, January, 1890.

Acrida turrita Linn. (larvæ).

Two specimens, Congo.

Paracinema tricolor Thunbg.

One specimen, Congo, January 2, 1890.

Epacromia tricoloripes St.

One specimen, Congo.

Stenobothrus sp. ?

One specimen, St. Paul de Loanda.

Tryxalis sp. ?

One specimen, Congo.

Gen. ? sp. ?

Three specimens, Congo.

Gen. ? sp. ?

Two specimens, St. Helena.

Family FORFICULIDÆ.

Sphingolabris sp. ?

Five specimens, Congo.

Labidura riparia Palis.

One specimen, Congo, December 25, 1889.

Order NEUROPTERA.

Family HEMEROBIIDÆ.

Subfamily MYRMELEONIDÆ.

A large Myrmeleonid (undetermined) having a wing expanse of 100 millimeters and a length of 40 millimeters, was collected at Congo, December 28. The thorax and head are black, the legs brown, and the abdominal joints brown, tipped with black.

Order PSEUDONEUROPTERA.

By P. P. CALVERT.

Family LIBELLULIDÆ *(sens. lat.)*.

Subfamily LIBELLULINÆ.

Diplax dilatata n. sp. Calvert. (Figs. 1 and 2.)

♂. Vertex hairy, brownish or brownish yellow above, blackish in front and on the sides; tip truncated, its outline very slightly concave from side to side.

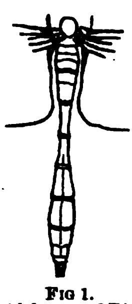

FIG 1. Abdomen of Diplax dilatata ♂ n. sp.

Frons hairy, brownish yellow or reddish, grooved above, with a rather wide blackish band in front of eyes and vertex; in front with two small dark spots. Nasus and rhinarium brownish yellow, rhinarium sometimes darker. Labrum reddish yellow with some obscure blackish marks. Labium black; its lobes brown, blackish on the inner and anterior margins and at joint with labium (at this joint sometimes yellow). Basal joint yellow. Occiput brown. Rear of eyes dark brown with three yellowish spots, a row of light-colored hairs from the right uppermost spot to the left one.

Prothorax blackish, anterior margin yellow; posterior lobe with a reddish tinge (dark red in life?), hind margin broad, bilobed, with a fringe of long light-colored hairs.

Thorax brownish yellow, hairy; median dorsal ridge blackish, reaching downwards to the front margin, which is also black, a brown humeral stripe, first and second lateral sutures each with a black stripe, a short, broader black stripe in front of the spiracle. The stripes on the sides reach down to black spots around the feet. Pectus mostly blackish.

Feet moderately long, black, femora sometimes brownish interiorly, posterior tibiæ with two rows of 10 to 12 spines; tarsal nails toothed before apex.

Abdomen compressed at the base, becoming narrower to the base of the fifth segment, whence it widens and thickens to the seventh segment, where it is wider than at the base; from the seventh segment it narrows to the apex, which is a little wider than at the base of the fifth segment; the dilated portion at seventh segment triangular in cross section. Color, brownish yellow, some parts with a reddish tinge (red in life?); segment 1 dark brown at base; 2 sometimes with a small median dorsal

brown spot; a brown dot on each side of the median dorsal line near the apex of 3 to 6, sometimes also on 7 and 8; 2 and 3, only, with a transverse carina.

Genitalia not prominent. Hamule bifid, internal branch terminating in a small, rather acute hook directed outwards; external branch much thicker; apex obtuse. Genital lobe with apex rounded, hairy.

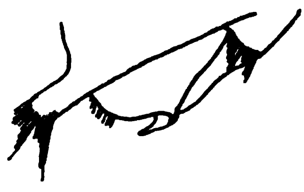

FIG. 2.
Genitalia of Diplax dilatata ♂ n. sp.

Appendages brownish yellow, with short hairs. Superiors of about the length of the eighth segment; viewed from above, they are straight, dilated on the inner side before the apex, which is acute, black; viewed from the side, they are directed slightly downwards to the extreme apex, which inclines slightly upwards (as in *vulgata*); on the under side are 9 to 13 black denticles corresponding in position to the dilatation on the inner side. Inferior appendage, viewed from the side, is concave above from base to apex, which latter is curved upwards and ends in a small black denticle on each side; this denticle extends a little beyond the last denticle on the under side of the superiors; viewed from below, the appendage is rather broad, triangular, apex truncated, slightly emarginate.

Wings hyaline, reticulation brownish, hind wings with a light yellow cloud alongside of the membranule, extending outwards to about the level of the basilar cross vein, and backwards but little farther than the apex of the membranule. Pterostigma 3 to 4 times as long as broad, brownish yellow, surmounting parts of two or three cells. Membranule moderate, whitish. Sectors of the arculus stalked. One basilar cross vein placed nearer the base than the first antecubital. Nodal sector slightly waved. No hypertrigonals. Front wings with 10 (occasionally 9 in one wing) antecubitals, the last not continuous; 10 to 12 postcubitals; discoidal triangle with one or two cross veins; internal triangle of 4 to 6 cells; four, then three rows of discoidal areolets. Hind wings with 7 antecubitals, the last continuous; 10 to 12 postcubitals; discoidal triangle free, its inner side in the prolongation of the arculus; no internal triangle; discoidal areolets three, then two rows increasing; sectors of the triangle arising from the same point.

One male differs in having an additional basilar cross vein placed so as almost to form an internal triangle on the right hind wing, an indication of the beginning of such a vein on the left hind wing, both hind wings with discoidal triangle crossed by one vein.

♀. Similar to the male; differs as follows: Lobes of the labium yellow, margined as in ♂. The first three segments of the abdomen yellow; 1 black at base, 2 and 3 brownish along the median dorsal line; a crooked brown stripe on the sides of 1 to 3; venter of 2 and 3 black. Remaining segments of abdomen lost.

Nine antecubitals to the front wings, last one on the right wing having a corresponding cross vein in the subcostal space although not continuous. Right-hand wing with 6 antecubitals. Two discoidal areolets at the triangle in hind wings.

Measurements: ♂. Total length, 44.5 to 47.5 millimeters. Abdomen (incl. app.), 26.5 to 31.5 millimeters. Superior appendages, 1.75 to 2 millimeters. Front wing, 35.5 to 37 millimeters. Hind wing, 33 to 34.5 millimeters. Pterostigma, 3.5 to 4 millimeters. Width of abdomen at base of 5, 1.5 millimeters. Width of abdomen at 7, 3 to 4 millimeters.

♀. Length, abdomen, appendages, ?. Front wing, 37.5 millimeters. Hind wing, 34.5 millimeters. Pterostigma, 3.5 millimeters.

Four males, one female from St. Helena. Dr. Hagen examined one of the males for me and wrote, "It is unknown to me." This species belongs to the group of genera embracing *Diplax*, *Thecadiplax*, and *Erythrodiplax* in Dr. Karsch's arrangement of the Libellulina (Berliner Ent. Zeit., XXXIII, pp. 347-392, 1890). I place it provisionally in *Diplax*.

Libellula (Orthetrum) capensis n. sp. Calvert. (Fig. 3.)

Libellula assimilis Hagen MS.

♂. Vertex reddish, in front black, tip bifid, apices acute. Frons reddish yellow, sides lighter, grooved above, front separated from each side by a vertical carina, the two carinæ united by a horizontal carina just above the lower margin of the frons. Nasus and rhinarium luteous. Labrum reddish yellow. Labium and its lobes brown Occiput reddish brown.

Prothorax with anterior lobe brown, posterior lobe yellowish, broad, its hind margin slightly notched in the middle.

Dorsum of thorax luteous, a faint indication of a brownish spot on each side of the median crest near its summit, and a brown humeral stripe. Sides yellowish, obscure, with ill-defined brown marks around the lateral sutures.

Feet luteous, tibiæ darker, apices of femora and tarsi black.

Abdomen rather slender, compressed at base, slightly contracted at the fourth segment becoming wider to the sixth, but not so wide as at base; from 6 tapering gradually to apex. First three segments luteous, an ill-defined brown stripe each side. Dorsum of remaining segments pruinose, under side of abdomen luteous.

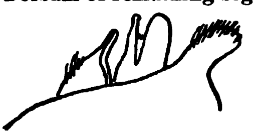

FIG. 3.
Genitalia of Libellula capensis ♂ n. sp.

Genitalia a little prominent. Anterior lamina with sides rounded to the apex, which is truncated. Hamule bifid, branches of equal length, straight, almost parallel, separated by but a short interval; inner branch black, slender, apex rounded, with a slight hook; outer branch luteous; much thicker, apex rounded. Genital lobe broad, apex rounded, hairy.

Superior appendages black, about as long as the ninth segment, similar to those of *D. dilatata* (*q. v.*). Inferior appendage luteous, sides blackish, similar to that of *dilatata*.

Wings hyaline, somewhat milky, a very slight yellowish cloud at base. Reticulation blackish, costa luteous exteriorly. Pterostigma, brownish yellow, three to four times as long as broad, surmounting two and parts of two other cells. Membranule blackish. Sectors of the arculus stalked. One basilar cross vein placed very nearly on a level with the first antecubital. Nodal sector waved. Frontwings with one hypertrigonal; 13 (right), 15 (left) antecubitals, the last one continuous; 11 postcubitals; discoidal triangle with one cross vein; internal triangle of three cells; three rows of discoidal areolets.

Hind wings with no hypertrigonals; 10 (right), 11 (left) antecubitals, the last one continuous; 11 (right), 10 (left) postcubitals; discoidal triangle free, its inner side slightly nearer the base than the prolongation of the arculus would be; no internal triangle; two rows of discoidal areolets, increasing; sectors of the triangle a little separated at their origin. Total length, 49 millimeters. Abdomen (incl. app.), 33.5 millimeters. Superior appendages, 2 millimeters. Front wing, 34.5 millimeters. Hind wing, 33 millimeters. Pterostigma, 3.5 millimeters.

One male from Cape Town. Dr. Hagen examined this specimen and wrote to me (September 2, 1890) it "is my *L. assimilis*, never published." This species belongs to the genus Orthetrum of Kirby's Revision.

Libellula (Orthetrum) caffra Burmeister. (Fig. 4.)

Dr. Hagen has determined two specimens for me as belonging to this species. They are a male from Congo and a female from Freetown, Sierra Leone. Both have a considerable portion of the abdomens wanting.

In his Revision of the Subfamily Libellulina (Trans. Zool. Soc. London, XII, pp. 249–348, 1889), Mr. W. F. Kirby refers *caffra* to his new genus *Thermorthemis* (p. 289). I think it rather belongs to his genus *Orthetrum*. *Thermorthemis* is stated (*l. c.*) to have the triangle in the forewings followed by four or five rows of cells;

Burmeister (Handbuch der Entom., II, pp. 855, 856) places *caffra* with species having "gleich anfangs drei Zellenreihen in dem Felde hinter dem Dreieck der Vorderflügel,"* and with this these two specimens agree. These two specimens also differ from the characters of *Thermorthemis* by having the pterostigma moderate; fore wings with 14 (♂) or 13 (♀) antecubitals, 10 (♂) or 9 (♀) postcubitals, discoidal triangle traversed by one vein, one hypertrigonal, internal triangle of 3 (in one wing 4) cells; hind wings with triangle free, no hypertrigonals, sectors of the triangle a little separated at base.


FIG. 4.
Genitalia Libellula caffra ♂ Burm.


FIG. 5.
Genitalia of Libellula sp ♂.


FIG. 6.
Genitalia of Libellula unifasciata ♂ Oliv.

Another male from Congo which, at first, I had also referred to *caffra*, may perhaps belong to another species, as there are differences in the genital hamule and in the coloring of the thorax. Unfortunately this male has also lost the greater part of the abdomen. (See accompanying figure, 5.)

Libellula (Cacergates) unifasciata Oliv. (Figs. 6 and 7) (**leucosticta** Burm.).

Eight males and three females from Congo. One male from Porto Grande, St. Vincent. One male from Angola, December 9.

The width of the dark band on the wings of the male varies; its least width on the fore wings is from the level of the second postcubital to that of the ending of the median sector; its greatest width on the same wings is from the level of the nodus to that of the inner side of the pterostigma.

This species is the type of the genus *Cacergates* Kirby.

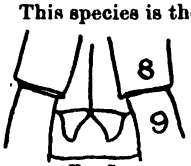

FIG. 7.
Vulva of Libellula unifasciata ♀ Oliv.

FIG. 8.
Vulva of Libellula rubrinervis ♀ Selys.


FIG. 9.
Genitalia of Libellula rubrinervis ♂ Selys.

Libellula (Trithemis) rubrinervis Selys. (Figs. 8 and 9.)

One male and one female from Congo.

Libellula (Crocothemis) erythræa Brullé. (Fig. 10.)

One male from Congo.

Libellula (Urothemis) edwardsii Selys. (Fig. 11.)

Three males from Congo agree with Baron de Selys's description (C. R. Soc. Ent. Belg, 4 Mai 1878, p. lxv.) Another male from Congo agrees quite well with Rambur's description of "*sanguinea* Burm." (Névroptères, p. 112), and differs from the males of *edwardsii* by the general reddish color of its body and reticulation, and by the size and color of the basal markings on the hind wings. I can find no structural differences between it and the males of *edwardsii*. The three males of *edwardsii* have on the hind wings a blackish-brown basal streak in the subcostal space and

*It was not until after I had entirely completed the MS. of this paper that I noticed that Dr. Karsch had previously pointed out (Berliner Ent. Zeit. XXXIII, p. 377. 1890) from the same quotation from Burmeister that *caffra* Burm. does not belong to *Thermorthemis*. Dr. Karsch there states that *caffra* is unknown to him.—P. P. C.

half of the costal space reaching a little more than halfway to the first antecubital, and a blackish-brown basal spot bounded anteriorly by the submedian nervure, extending outwards to the level of the first antecubital (not reaching the triangle), and not reaching the anal border. In the other male the streak and spot are similarly situated, and are reddish-brown, with the veins lighter; the streak reaches outwards half way between the first and second antecubitals, the spot a little farther so as to extend a short distance into the triangle.

FIG. 10.
Genitalia of Libellula erythræa ♂.

Burmeister describes (Handb. d. Ent., II, p. 858, No. 60) both male and female of *sanguinea* from Madras. Rambur says that he has described only the male [of "*sanguinea* Burm."] from Senegal. Baron de Selys states (*l. c.*, p. lxiv) that *signata* Ramb. (Névr., p. 117, only the female, locality unknown) is synonymous with *sanguinea* Burm. If *signata* Ramb. and *sanguinea* Ramb. are different species, as seems probable, *sanguinea* Ramb. may be a variety of *edwardsii*, or founded on younger specimens thereof. It should be noted moreover, that *edwardsii* is recorded from Dakar in Senegal (Selys, *l. c.*, p. lxv). The lighter colors of *sanguinea* Ramb. approach more nearly those of the female than of the male of *edwardsii*.

FIG. 11.
Genitalia of Libellula edwardsii ♂ Selys.

Two Libelluline nymphs from Congo are included in the collection.

Subfamily AGRIONINÆ.

Pseudagrion glaucescens Selys.

One male from Porto Grande, St. Vincent.

Pseudagrion torridum ? Selys.

One specimen from Congo, with the abdomen wanting (except the first segment), may belong to this species.

Pseudagrion species.

One male from Porto Grande, St. Vincent, but with the head wanting. Seems to belong to an undescribed species of *Pseudagrion*.

ARACHNIDA.

ARANEINA.

By NATHAN BANKS.

Family ATTIDÆ.

Menemerus marginellus, Simon.

One damaged specimen from "Congo."

Hasarius adsonii? Aud. & Sav.

Three specimens which probably belong to this common tropical form, from Ascension Island.

Family LYCOSIDÆ.

Lycosa sp?

One very much damaged specimen from Ascension Island.

Lycosa brevipes, nov. sp. Banks.

Length, ♀, 10 millimeters. Cephalothorax yellowish brown, with three yellow stripes; a median, widest behind; and a submarginal one on each side, wider than the median one and but slightly separated from the margin. On each side of the anterior part of the median stripe is a yellow, elongate spot. Eyes black; mandibles reddish; palpi and legs yellowish, without markings; sternum yellow; abdomen gray above, yellow beneath; a narrow yellow median stripe on anterior part of dorsum, bounded by black; epigynum reddish; spinnerets yellow.

FIG. 12. Epigynum of Lycosa brevipes.

Cephalothorax narrow, pars cephalica not very high. Anterior row of eyes straight, as long as second row, M. E. larger than S. E. Eyes of third row same size as those of second row and about twice as far apart; legs short and stout; sternum broad, nearly round; abdomen oblong oval, widest behind the middle. Epigynum small. One specimen, "Congo."

Pardosa valida nov. sp. Banks.

Length, ♀, 6 millimeters. Cephalothorax reddish, blackened in eye region and on margins; mandibles dark, red brown; sternum black; palpi and legs yellowish, with black rings and spots; abdomen dark brown, almost black above, venter lighter brown, clothed with white hairs; epigynum red brown; spinnerets black.

Cephalothorax broad, sloping suddenly behind dorsal groove. Anterior row of eyes curved, little shorter than second row, S. E. slightly lower than M. E., equal in size. Eyes of second and third rows equal in size, the latter as far from the former as the former are from each other. Legs long, especially the fourth pair, the tip of the femur of which reaches the end of the abdomen. Abdomen elliptical, about as long as the cephalothorax. Two specimens, "Congo;" another, much damaged, from "Sierra Leone."

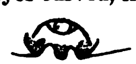

FIG. 13. Epigynum of Pardosa valida.

ON A NEW GENUS AND SOME NEW SPECIES OF ARANEÆ FROM THE WEST COAST OF AFRICA COLLECTED BY THE U. S. STEAMER ENTERPRISE.

By GEO. MARX.

1. Selenocosmia nigroventris, nov. spec. Male. Figs. *ia* and *ib*.

Cephalothorax long, 14 millimeters; broad in the middle region, 12 millimeters.

Leg I. Femur, 12 millimeters; patella and tibia, 14.2; metatarsus, 8; tarsus, 5.8; total, 40 millimeters.

Leg II. Femur, 11 millimeters; patella and tibia, 12.4; metatarsus, 8; tarsus, 5.5; total, 36.9 millimeters.

Leg III. Femur, 8.6 millimeters; patella and tibia, 10.6; metatarsus, 8.5; tarsus, 55; total, 33.2 millimeters.

Leg IV. Femur, 11.3 millimeters; patella and tibia, 13.5; metatarsus, 11; tarsus, 5.6; total, 41.4 millimeters.

The whole upper surface of cephax, abdomen, and legs densely covered with light mouse-colored pubescence; sternum, maxillæ, labium; femoral joint of palpi and coxæ velvety black; abdomen at the central region also black; at the inner side of maxillæ a fringe of long, pink-colored hairs.

Anterior ME largest; posterior ME very close to the former and contiguous with the posterior L. E.; eye, tubercle, transverse, oval.

One male specimen from the Congo.

2. Cydrela brunnea, nov. spec. Female. Figs. 2a–d.

Cephalothorax long, 5.5 millimeters; broad, in the middle, 4.3; abdomen long, 6.5 millimeters.

Leg I. Femur, 3.8; patella and tibia, 4.2; metatarsus, 2.5; tarsus, 2; total, 12.5 millimeters.

Leg II. Femur, 3.4; patella and tibia 3.7; metatarsus, 2.2; tarsus, 1.6; total, 10.9 millimeters.

Leg III. Femur, 3.3; patella and tibia, 3.6; metatarsus 2.7; tarsus, 1.3; total, 10.9 millimeters.

Leg IV. Femur, 3.8; patella and tibia, 4.5; metatarsus, 3.5; tarsus, 2.8; total, 14.6 millimeters.

Palpi femur, 3.1 long, 1.5 thick; patella and tibia, long 2.8, thick 1.3; Tarsus, long 1.5.

Cephax, trophi, sternum and legs shining dark reddish brown, the tibiæ, metatarsi and tarsi a little lighter; abdomen * brown, with some spots, all parts sparsely covered with yellowish hairs.

Cephalothorax oval, p. cephal. impressed at the sides, attenuated and globulate in front; high, declining moderately from the center to the front and the back, but steeply sloping transversely; median fossa short and very distinct, clypeus high and somewhat projecting.

The two anterior eyes contiguous, a little smaller than those of the middle row, which are the largest of all and separated from each other by a space which hardly equals their diameter; the smaller posterior ME are the same distance apart from the eyes of the second row as these are from the eyes of the first row; they are separated from each other by their diameter; the two lateral eyes of the third row stand farther back than the median eyes, and form a recurved line; clypeus higher than the space between the eyes of the first and the second rows.

Mandibles stout, attenuating toward the tip and directed slightly backward. Maxillæ subtriangular, much broader than high, surrounding the labium and nearly meeting each other in front of the latter, drawn out externally for the insertion of the palpi. Labium oblong ovate and nearly twice as high as it is broad. Sternum sinuate in front, posteriorly, slightly pointed, with swellings opposite the coxæ, not higher than broad, and flat. Palpi nearly three times as stout as the legs; femoral joint clavate at apex, tibial joint at the inner side with a row of short blunt spines; tarsus terminating into a long strong tooth and armed at the sides with double rows of similar spines.

Legs slender, hairy, all joints but the femora with numerous short spines on the superior surface and longer ones beneath, which are particularly numerous at the distal ends of tibiæ and metatarsi.—Congo.

3. Cydrela maculata, nov. spec. Female. Fig. 3a–b.

Cephalothorax long, 4 millimeters; broad in the middle, 2.2; abdomen long, 4—broad, 3.

Leg I. Femur, 2; patella and tibia, 3; metatarsus, 1.6; total, 7.8 millimeters.

Leg II. Femur, 1.6; patella and tibia, 2; metatarsus, 1.3; total, 5.7 millimeters.

Leg III. Femur, 1.8; patella and tibia, 2; metatarsus, 1.5; total, 6.3 millimeters.

Leg IV. Femur, 2.4; patella and tibia, 2.4; metatarsus, 2; total, 8 millimeters.

Cephalothorax, mouth parts, sternum, palpi, and legs dark brown; coxæ lighter colored, abdomen brownish with two round yellowish spots closely together at the base of the dorsum, and two or three short, transverse, recurved lines of the same color above the spinnerets; at the under side the basal region and the spinnerets are light brown.

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* The abdomen is so much shriveled that it is impossible to determine its form or color.

Cephax oblong ovate, high, not much narrower in front than in the middle region: seen from the side the dorsum is highly arched in the longitudinal axis. P. cephal. not distinctly separated from p. thorax, in front rounded and globulate, median fossa short and very deep.

Eyes subequal, anterior eyes separated from each other by a space equal to three times their diameter. Space between the eyes of the second row about equal to their diameter; these eyes are removed from the anterior by a space equal to the last mentioned. Posterior eye row strongly recurved, the middle eyes a little farther apart than the eyes of the second row, the posterior lateral eyes removed from the middle by a distance equal to three times their diameter.

Cephax twice as long as broad. Legs on all joints but the femora with a few short spines, slender and short. Palpi twice as stout as femur I and armed like brunnea.

Four specimens from Kilimanjaro, Africa.

Machomenus nov. genus.

Cephalothorax perfectly flat, a little longer than broad, much rounded at the sides, a little constricted behind the posterior lateral eyes. A distinct and very prominent transverse ridge between the two eye rows, extending outward, forming a sharp and prominent point on each side.

Eyes eight, in two transverse rows, the anterior straight row situate at the vertical front of the cephalothorax before the ridge, the posterior slightly recurved row with the two middle eyes on the flat dorsal surface and the lateral eyes on the posterior angle of the projecting point of the ridge. The anterior lateral eyes the largest; space between the anterior middle eyes equals about one and one-half of their diameter, and they are about twice as far removed from the anterior lateral eyes. The posterior lateral eyes a little larger than posterior middle; the eyes of this row are about equidistant.

Mandibles weak, short, directed backward. Maxillæ inclined over the labium, truncate at apex, labium broader than long, subtriangular, rounded at tip.

Legs: The two anterior pairs much longer and stouter than the two posterior pairs; first pair a little longer than second. Tibiæ with a few scattered spines at the inner side, and a double row of prominent spines at the metatarsi of the two anterior pairs; no scopala on the tarsi.

Machomenus albidus nov. sp. Male (undeveloped), Fig. 4*a–c*.

Cephalothorax whitish, with two longitudinal brownish bands removed from the lateral borders by a space equaling their width. Mouth parts, sternum, and legs yellow, mottled with white spots. Abdomen oblong-ovate, with two dark spots in the first third of its length and a number of transverse lines on the posterior region. Several undeveloped males and females from Congo.

5. **Selenops brownii** nov. sp. Female, Fig 5*a*.

Cephalothorax long, 4.5; broad in the middle, 5.4; broad in front, 2.6 millimeters. Abdomen long, 6.5; broad, 5; first leg, 15.6 millimeters long; second leg, 18 millimeters; third leg, 17.5 millimeters; fourth leg, 18 millimeters.

Cephalothorax uniformly reddish, testaceous, with brownish narrow lateral borders; p. cephal slightly more red; mouth parts of the same color, apex of maxillæ and labium with a paler border; sternum paler. Abdomen olive-yellowish brown, with three pair of white spots in the middle region and several similar ones at the apical border, several indistinct transverse dark wavy bands and brown spots; at the under side pale grayish-yellow; legs yellowish at the inner side, with a brownish hue, and at the tibiæ with two dark rings, which are more distinct in the two anterior pairs than in the two posterior; all eyes surrounded by a black area, which is less

distinct at the central eye and most prominent in the posterior lateral; these latter are situated upon a large black tubercle.

The anterior eye row nearly straight, close to the margin of the clypeus; the median eyes about their diameter apart, the smaller lateral oblique. The posterior row recurved, the middle eyes a little larger than those of the first row and only apart from these by a space equaling their radius. The posterior lateral eyes the largest, situate at the outer side of a large tubercle; the posterior middle eyes are further apart than they are from the posterior lateral.

Mandibles subgeniculate at the base, directed forward and diverging.

Maxillæ arched, at the basal half concave, surrounding the labium; at the distal half rounded at both sides to an oval. Labium, about half as long as maxillæ; a little longer than broad, wider at apex than at the base, and rounded at tip. Sternum oval, slightly longer than broad.

Abdomen truncate in front, with nearly parallel sides and pointed at apex, covered with short, bristle like hairs.

Legs long and slender, with a sparse, fine pubescence; the tibiæ of the two anterior pair with three pair, the metatarsi with two pair, of very long spines. Several females from the Congo.

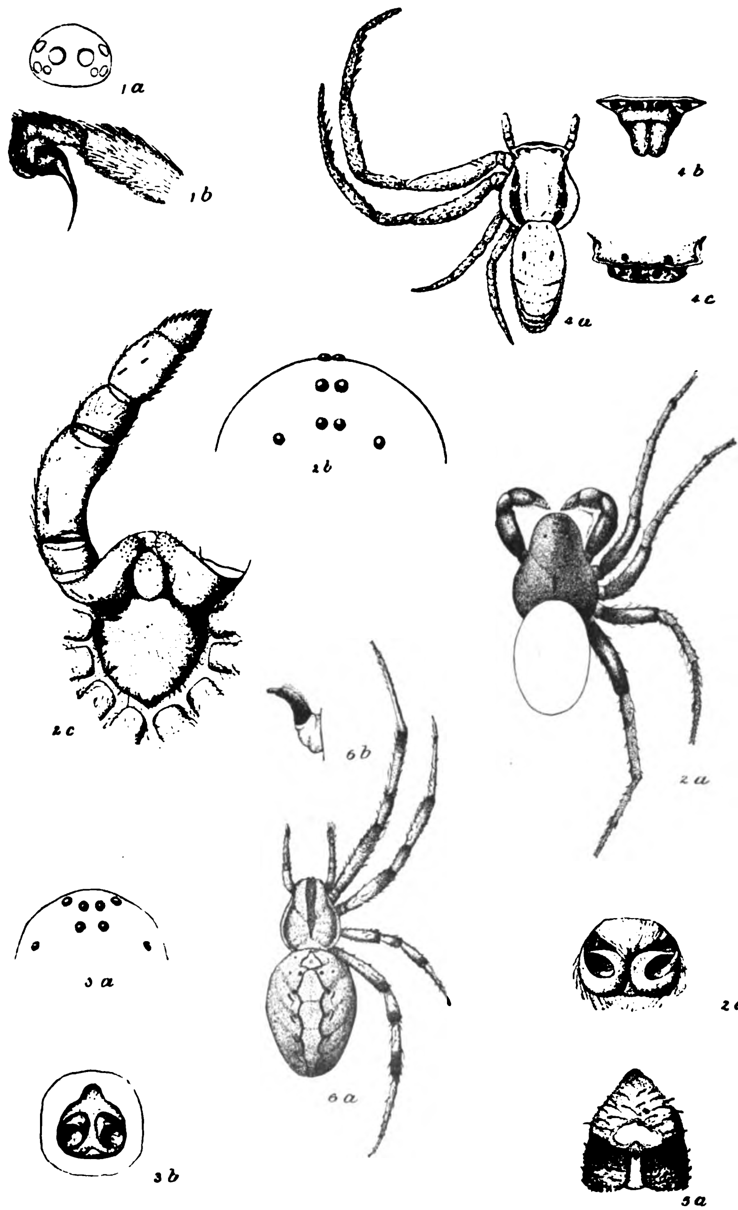
6. **Epeira eclipsis** nov. sp. Fig. 6*a–b*.

Cephalothorax long, 5.4 millimeters; broad in the middle, 4.3; broad in front 2 millimeters; abdomen long, 10; broad, 6.5 millimeters; first leg, 20 millimeters long; second, 18.5; third, 12; fourth, 20 millimeters.

Cephalothorax pale yellow, with a dark-brown strip running over the dorsum and a similar one on each side, not quite at the margin. Abdomen grayish, mottled with darker and lighter spots at the sides, a scalloped longitudinal band running over the dorsum, a few brown short stripes near the angles of the scallops. At the under side, in the central region, a black longitudinal band running from the epigynum to the spinnerets, bordered by a narrow white stripe which widens into an oval spot at the middle region, and a similar but smaller spot at the base of the spinnerets. Legs reddish-yellow, with dark-brown bands and with many short spines. Sternum blackish-brown, with a narrow yellow longitudinal band. Maxillæ and labium dark brown, with lighter tips. Congo.

EXPLANATION OF PLATE LXX.

1*a*. *Selenocosmia nigroventris* n. sp., eyes.
1*b*. *Selenocosmia nigroventris*, male palpas.
2*a*. *Cydrela brunnea* n. p., female, enlarged.
2*b*. *Cydrela brunnea*, eyes.
2*c*. *Cydrela brunnea*, palpi, trophi, and sternum.
2*d*. *Cydrela brunnea*, epigynum
3*a*. *Cydrela maculata* n. sp., eyes.
3*b*. *Cydrela maculata*, epigynum.
4*a*. *Machomenus albidus* n. sp., male, undeveloped, enlarged.
4*b*. *Machomenus albidus*, face from the front.
4*c*. *Machomenus albidus*, face tilted upward.
5*a*. *Selenops brownii* n. sp., epigynum.
6*a*. *Epeira eclipsis* n. sp., female enlarged.
6*b*. *Epeira eclipsis*, epigynum.



Marx del.

ARACHNIDA OF ECLIPSE EXPEDITION.

ON SOME FOSSIL UNIOS AND OTHER FRESH-WATER SHELLS FROM THE DRIFT AT TORONTO, CANADA: WITH A REVIEW OF THE DISTRIBUTION OF THE UNIONIDÆ OF NORTHEASTERN NORTH AMERICA.

BY

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Aid, Department of Mollusks.

The United States National Museum has recently received from Mr. A. P. Coleman, of the School of Practical Science of Toronto, a number of fossil Unios and other fresh-water shells from the drift of that city, the former of which are highly important in their bearings on the distribution of certain species of that genus. They were obtained from a bed of sand between two glacial beds in a railway cut on the Belt Line, north of Winchester street, 20 to 25 feet above the River Don.

Eight species and one variety of Unios and six species of other fresh-water shells were sent, all of which are living at the present day. All the Unios are characteristic forms of the Mississippi Valley, but of these only three species have ever been reported from Canada.

The material was received in rather bad condition; in the case of the Unios the valves were all more or less broken and somewhat crumbled, yet I have been able to identify with certainty most of the specimens.

It may be well before giving a list of these specimens, and stating the range which they at present occupy, to briefly outline the distribution of the *Unionidæ* of Eastern North America. I shall not go into details regarding this matter, which I have treated at length in a paper recently published in the American Naturalist.*

Suffice it to say that at the present time a common assemblage of the Naiades inhabits the entire Mississippi Drainage Area, to the almost absolute exclusion of all other forms. Within this region is found the most magnificent development of the Unionidæ of any part of the world. It is an ancient fauna, having descended in a no doubt unbroken line, and through forms which have in some cases scarcely changed, from the Cretaceous period. The species and individuals are exceedingly numerous; they are often very large and ponderous, ornamented with beautiful and odd patterns of color and sculpture. Unione life seems to have run riot here, and there is only one other area in the world at all comparable to it in this respect—that of China—which has no doubt received a part of its stock from the same source as the territory in question.

While many species actually found within this area, and others belonging with groups having their metropolis here, have spread far out

*On the Relationships and Distribution of the North American *Unionidæ*, with notes on the West Coast Species. American Naturalist, Vol. XXVII, No. 316, p. 353.

into other regions, I know of but a single species belonging elsewhere that has been found within this basin, a case that I shall refer to later.*

The streams of Texas are almost wholly peopled with these and closely related forms, which, in some cases, extend well into Eastern Mexico, and even Central and Northern South America. To the northward and eastward a number of characteristic Mississippi Uniones have extended into the Red River of the North, the Saskatchewan, the Mackenzie, to the Hudson Bay Territory, Michigan, and Canada. It is probable that one of these species is even found in the Columbia River, *Unio luteolus*, where it is known by the name of *U. oregonensis*. It will be therefore seen that the Naiades of this region are vigorous and aggressive.

The waters that drain into the Atlantic are inhabited by a totally different set of Uniones, which, as a rule, are moderate in size, of rather frail structure, and not remarkable for color or sculpture. The Appalachian chain acts as an almost total barrier to the mingling of the forms of the two areas, and, so far as is known, only a very few of these eastern species extend westward to the headwaters of the St. Lawrence.

The following is a list of shells sent by Mr. Coleman:

Unio phaseolus Hild. Six valves. An abundant, widely distributed species, whose recorded northern limits are western New York, Cheboygan County, Michigan, near the Mackinaw Straits, and St. Peters, Minn.

Unio occidens Lea? Part of a right valve. It is found living as far north as Ottawa, Canada.

Unio pustulosus Lea. Six valves in bad condition, which I believe to be typical *pustulosus*. Not reported outside the Mississippi area. It extends north to St. Peters, Minn., and southern Wisconsin.

Unio pustulosus var. *Schoolcrafti* Lea. Four valves and the posterior part of a pair. It occurs north to Grand Rapids, Mich., and Lake Erie.

Unio undulatus Bar. Part of a left valve in bad condition, but undoubtedly this species. Mississippi area into Texas, north to Ottawa, and Red River of the North.

Unio rectus Lam. Right valve of a young specimen. Widely distributed, extending to Ottawa and the Red River of the North.

* No. 85981 of the Isaac Lea collection, now in the National Museum, was sent to Mr. Lea from the ponds of the Wabash by Dr. Lewis, and labeled by the latter "*Unio subrostratus* Say." The former changed it to *nasutus*. No. 85938, same collection, Foote's Pond, Gibson County, Indiana, was labeled *U. nasutus* by Lea. I have carefully examined these shells and unhesitatingly pronounce them to be *U. subrostratus*, a form closely resembling *U. nasutus* at times, but always more inflated and differently shaped in the ventral region. There are authentic shells of *U. nasutus* from Ohio in Dr. Lea's collection, but they are all from streams that fall into Lake Erie. One Unio in the Museum collection (No. 26060), from J. A. Lapham, is labeled *U. radiatus*, Pine, northeast boundary of Wisconsin. Pine County is in Minnesota, near Lake Superior, and is drained by the St. Croix River, a tributary of the Mississippi. I am inclined to refer this specimen to the very nearly related *Unio luteolus*, a common Mississippi Basin species.

Unio trigonus Lea. Fourteen valves. Its northern limits are western New York, southern Michigan, and St. Peters, Minn.

Unio solidus Lea. Eleven valves. Not hitherto reported outside the Mississippi Basin.

Unio clavus Lam? Five valves in bad condition, which, after the most careful and exhaustive comparison, I refer to this species. It is confined to-day to the Mississippi area, reaching north into western New York.

Quite a number of specimens of the other fresh-water shells were received in bad condition. These are *Pleurocera elevatum* Lea, *P. subulare* Lea, *P. pallidum* Lea? and an undetermined species; *Valvata sincera* Say, remarkably depressed, and *Sphærium striatinum* Lam. All of these are now found living in Canada, except the first mentioned species, which is, I believe, confined to the Mississippi area.

The theory founded by Agassiz and elaborated by Dawson, Upham, Gilbert, Tyrrell, and others, that during the glacial period the archæan region of Canada was elevated from 1,000 to 2,000 feet above its present level, and that it was covered with an ice mantle from 3,000 to 6,000 feet thick, a mantle which in the eastern part of the United States extended down to latitude 38° or 40°; that in the Champlain period which followed there was a subsidence over this area, during which great lakes were formed by the melting ice, whose northern shores were the yet remaining wall of ice, and whose southern borders were the land that sloped northward; and that they drained into the Mississippi system, is most strongly confirmed by the evidence of these fossil Unios, and by every fact of the distribution of the Naiades in this general region to-day. It is believed that the entire system of the present Great Lakes was united, and that at one time it covered a considerable part of lower Michigan, and extended well into Ohio, Indiana, and Illinois. What has since become the Red River of the North, which at that time was an arm of the great lake Agassiz, no doubt had its outlet into the Upper Mississippi from the small Bois des Sioux River, which rises in Lake Traverse, and from this connected with Big Stone Lake, near by, the head of the Minnesota River.* The waters of the St. Lawrence, dammed with ice, could only escape into the Mississippi system.

It is quite probable that if the species of Naiades which now are found on the Atlantic slope inhabited any considerable part of the upper St. Lawrence and northern drainage systems previous to the glacial period, the great cap of ice grinding over the country, together with the rigorous climate, nearly or quite exterminated them in this area. As evidence in this direction, the case of *Margaritana margaritifera* may be cited. It is an oriental species, having its metropolis in northern Europe and Asia, which has crossed over into North America in all

*Geological and Natural History Survey of Canada, new series, Vol. VI, 1888-'89, p. 5. E.

probability by a now submerged landway, and to-day is found in British Columbia, Washington, Oregon, northern California, and in the upper waters of the Missouri. It is again met with in eastern Canada, New England, Pennsylvania, and New York, but has not been reported from any of the intervening territory. The suggestion made several years ago by Prof. A. G. Wetherby* that it had been destroyed in this region by glacial action seems the most reasonable, and it is possible that at the eastern side of the continent it might have survived in the area not covered by the ice cap or that it may have been driven to the southward before it. This is the only naiad now found living within the Mississippi drainage area that may said to belong to the Atlantic system, and it is undoubtedly an immigrant. It probably entered the Missouri through streams which connected that river with the Northwestern lake system.

Unio radiatus, a characteristic Atlantic drainage form, has been reported from Lake Winnipeg and the Nelson River,† but it approaches so near to *Unio luteolus*, a common Mississippi shell, that the identification may be considered somewhat doubtful. *Unio complanatus*, another characteristic Atlantic area species, has, on the excellent authority of Mr. Bryant Walker, been found in the southern peninsula of Michigan, and *Unio nasutus*, a third abundant and widespread eastern form, is frequently met with in that state, and in streams in northern Ohio that drain into Lake Erie. But the Red River of the North, so far as is known, is peopled wholly with Mississippi Valley Naiades, and some of them extend to the Mackenzie River.

At the time during the Champlain period when the waters of the northern lake region overflowed into the Mississippi Basin, many of the hardier, more vigorous, and characteristic species of the latter territory migrated northward and established themselves; most of them remain in the streams that now drain northward and northeastward, but a few have possibly retreated, while others, including three of those received from Toronto, are to-day in all probability confined to the Mississippi Valley. The lower peninsula of Michigan is almost exclusively inhabited by these forms, as well as the Great Lakes, and they extend well down the St. Lawrence and north and east into Canada.

To briefly recapitulate, then, the Unio fauna of the Mississippi Valley is remarkably distinct, being nearly related only to a part of that of northeastern Asia. It is an old fauna, dating back through an almost unbroken series of species to the Laramie group of the Cretaceous, and it is remarkably developed in large, vigorous species and numerous individuals. That these forms are dominant is proven by the fact that they so exclusively occupy this vast area, and that they have spread so widely into other regions, through a great variety of climate and conditions.

* Jl. Cin. Soc. Nat. Hist. July, 1881, p. 7.

† Land and fresh-water shells of Manitoba. Robert Christy.

The *Unionidæ* of the Atlantic slope are far less vigorous and aggressive, and evidently are not fitted to take possession of wide and diversified areas. If they occupied any considerable part of the great British American plain before the drift period, it is not at all improbable that they were well-nigh exterminated by the onward movement of the great cap of ice, which relentlessly ground its way from north to south over the face of the country. At the close of the ice age, when this great glacial sheet began to melt away at its southern border, the water of this great region, which sloped to the northward and eastward, dammed up by the great ice wall in that direction, was forced over into the Mississippi through various outlets, and the Unionids of the latter territory, finding an easy entrance into a region almost or quite destitute of other forms, rapidly worked in and became the dominant fauna when the great wall had melted away and the streams resumed their normal courses.

The absence of the Atlantic species to-day throughout a large part of the upper St. Lawrence region may perhaps be accounted for by supposing that they have never been able to cope with and dispossess their more persitent relatives from the Mississippi Valley, though the evidence afforded by the fossils described in this paper would go to show that, to a certain extent, some of them, at least, had retreated.

Mr. Dall has called my attention to the important bearing which these fossils may have (if the geological facts stated be fully confirmed by further exploration) upon the theory of a mild interglacial period, preceded and followed by an advance of the ice. If the ice receded to the vicinity of Toronto, allowing these Mississippi species to attain to that region, the fact that they did not establish themselves there would be easily accounted for by the subsequent advance of the ice and the destruction of the colony. The final melting and disappearance of the ice cap, being complicated by changes in the direction of the drainage, might not afford a second opportunity for the immigration of the species in question.

DESCRIPTIONS OF SOME NEW BIRDS COLLECTED ON THE ISLANDS OF ALDABRA AND ASSUMPTION, NORTHWEST OF MADAGASCAR, BY Dr. W. L. ABBOTT.

BY

ROBERT RIDGWAY.

Curator of the Department of Birds.

1. Ixocincla madagascariensis rostrata subsp. nov.

SUBSP. CHAR.—Similar to true *I. madagascariensis*, but larger, the bill especially, and coloration paler.

HAB.—Aldabra and Gloriosa islands.

Type, No. 128,658, male ad., Aldabra Island, October 2, 1892; Dr. W. L. Abbott. Length (before skinning), 9⅝ inches; wing, 4.50; tail, 4.00; exposed culmen, 0.82; depth of bill through nostril, 0.28; tarsus, 0.86; middle toe, 0.65. "Bill orange-red, tip black; feet fleshy brown." (ABBOTT, MS.)

2. Buchanga aldabrana sp. nov.

SP. CHAR.—Differing from *B. atra* in larger and more strongly hooked bill, much longer nasal plumes (reaching halfway from nostrils to tip of bill), much narrower rectrices, and in the very pale coloration of the female.

Adult male (type, No. 128,719, U. S. Nat. Mus., Aldabra Island, October 8, 1892; Dr. W. L. Abbott): Entirely black, glossed with greenish blue, the remiges and rectrices much duller, more brownish, and very faintly glossed. "Irides red, bill and feet black." Length (before skinning), 11.25; wing, 5.30; tail, 5.55; middle feathers, 4.20; culmen (from extreme base), 1.15; depth of bill through nostril, 0.38; tarsus, 0.92; middle toe, 0.60.

Adult female (No. 128,722, same locality and collector, October 2, 1892): Above dull slate-gray, the margins of the feathers on forehead and hind neck and lower part of rump approaching grayish white; wing-coverts dull greenish slate indistinctly edged with dull brownish white; remiges and rectrices dull grayish brown, edged with paler. Under parts grayish white, the feathers of the breast, belly, etc., dusky grayish be-

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neath the surface; under wing-coverts almost wholly pure white. Bill, legs, and feet black; "irides reddish brown." Length (before skinning), 9.75; wing, 4.80; tail, 4.80; middle feathers, 4.08; culmen (to concealed base), 1.12; depth of bill through nostril, 0.38; tarsus, 0.90; middle toe, 0.60.

Immature males are variously intermediate in color between the adult male and adult female.

The collection contains three adult males, two immature males, and one adult female, representing dates from October 2–19, inclusive.

3. **Foudia aldabrana** sp. nov.

Sp. Char.—Similar to *F. madagascariensis* (Linn.), but very much larger.

Adult male (type, No. 128,692, U. S. Nat. Mus., Aldabra Island, October 5, 1892; Dr. W. L. Abbott): Head, neck, chest, and upper breast bright scarlet (flame scarlet on under parts); rest of under parts rather light chrome-yellow, tinged with orange on abdomen and with scarlet on the crissum. Lores and orbits black. Back and scapulars light yellowish olive broadly streaked with black; rump plain light tawny olive-brown; upper tail-coverts flame-scarlet. Wings dull blackish, all the feathers margined with light olive or olive-yellowish; tail olive-grayish, the feathers edged with yellowish olive. "Bill black; irides dark brown; feet brownish flesh." Length (before skinning), 6.50 inches; wing, 3.30; tail, 2.10; culmen, 0.75; depth of bill at base, 0.50; tarsus, 0.92; middle toe, 0.65.

Adult female (No. 128,690, same locality and collector, October 3): Pileum and hind neck deep olive-buff, narrowly and rather indistinctly streaked with dusky; superciliary stripe, cheeks, and sides of neck, light brownish yellow; a post-ocular streak of dusky; anterior under parts pale Naples-yellow (palest on throat), the posterior lower parts deeper yellow. Otherwise like the adult male, but without trace of red anywhere. "Upper mandible horny brown, lower mandible pale horny; feet flesh-color." Length (before skinning), 5.50; wing, 3.05; tail, 2.10; culmen, 0.70; depth of bill at base, 0.50; tarsus, 0.85; middle toe, 0.60.

Two other adult males show a mixture of red on the back, and one of them has the lower rump, as well as the upper tail-coverts, red. It is therefore probable that in full plumage this species has the red as extensive as in *F. madagascariensis*.

A young male is like the female described above, but is somewhat brighter yellow beneath.

4. **Rougetius aldabranus** sp. nov.

Sp. Char.—Similar to *R. gularis*, of Assumption, but without trace of dusky streaks on dorsal region, and with white bars on belly and flanks much less distinct (sometimes almost wanting).

Type, No. 128,835, U. S. Nat. Mus., Aldabra Island, October 10, 1892; Dr. W. L. Abbott. Length (before skinning), 12.50 inches, "irides chestnut-brown; feet blackish brown; bill black, base pink."

Eight adults from Aldabra compared with four from Assumption Island agree in the above-mentioned characters. In the type, there is scarcely a trace of white bars on the abdomen, while those on the flanks and thighs are nearly obsolete.* Other specimens, however, have these markings well developed, though never so broad and distinct as in *R. gularis*, while in none of them is there even a trace of the blackish streaks on the back, which are very conspicuous in all the birds from Assumption.

5. Ibis abbotti sp. nov.

SP. CHAR.—Similar to *I. bernieri*, as distinguished from *I. æthiopica* but lower neck naked and minutely papillose; remiges without dark-colored tips (blackish gray in *I. bernieri*, dark metallic green in *I. æthiopica*); decomposed tertials greenish blue on outer, grayish green on inner, webs and iris light blue instead of white.

HAB.—Aldabra Island.

Type, No. 128,812, female ad., Aldabra Island, October 8, 1892; Dr. W. L. Abbott.

6. Sula abbotti sp. nov.

SP. CHAR.—Most like *S. cyanops*, but bill much more robust, and coloration different, the prevailing color of the wings and tail deep black instead of grayish brown, the wing-feathers (both remiges and coverts) with inner webs and bases largely and abruptly pure white, and the upper tail-coverts and flanks marked with guttate or wedge-shaped spots of black.

Adult male (type, No. 128,761, Assumption Island, Indian Ocean, September 18, 1892; Dr. W. L. Abbott): Head, neck, back, rump, upper tail-coverts, and entire under parts pure white; scapulars and wing-coverts pure white basally, grayish black terminally, the former mostly concealed, but frequently exposed as angular spots, or streaks, particularly on the lesser and middle wing-coverts; greater coverts with inner webs pure white, except at tip; remiges and primary-coverts black superficially, but inner webs of secondaries chiefly (those of innermost feathers wholly) pure white, and those of the primaries also largely pure white, this color reaching to the shaft on the basal portion of the first quill, which also has the outer web white, and the shaft yellowish white, at base; on the innermost primary the white forms a broad edging which extends nearly to the tip, gradually running out to the edge, but at the base occupying the entire width of the web. Tail deep black, the feathers (except middle pair) sharply tipped with pure white, and broadly edged with the same at the base. Each of the upper tail-coverts has a large wedge-shaped median spot of black, and many of the feathers of

the flanks are similarly marked. "Iris dark brown; feet leaden gray, lower parts of webs black; tip of bill [for about 1 inch] black; [rest of] bill fleshy white; orbital skin black; gular pouch light green." (Abbott, MS.)

Total length (skin), about 28 inches; wing, 18; tail, 8.40, outer feathers 3.20 shorter; culmen, 4.40; depth of bill at base (in front of lores), 1.65, width at same point, 1.22; tarsus, 2.00; middle toe, 3.50.

This fine species is a little larger than *S. cyanops*, and of similar general appearance, but differs very much both in form and coloration. The bill is much heavier than in that species, for while but little longer it is altogether deeper and broader through the base. The serrations of the tomia are also much coarser. The tarsus is decidedly shorter but the toes much longer than in *S. cyanops*, and the covering of both legs and feet is far rougher than in that or any other species of the genus. As to coloration, the most conspicuous features are the sharply defined wedged-shaped black markings, on a pure white ground, on the upper tail-coverts and flanks, the extensively white inner webs of the remiges, and the positively black, instead of brown, general color of wings and tail. Wherever the white and black come into juxtaposition there is always a bold line of junction, and in no case a gradual shading together of the two colors.

7. Turtur saturatus sp. nov.

Sp. Char.—Similar to *T. aldabranus*, but much darker; the whole back rich purplish chocolate, the head, neck, and chest similar but slightly paler; light-colored tips of rectrices more restricted and more tinged with gray (wholly gray in adult female); adult male with sides of neck distinctly glossed with green.

Hab.—Amirante group (Ile Poivre; Ile Alphonse?).

Type, No. 128,725, male ad., Ile Poirve, August 22, 1892; Dr. W. L. Abbott.

NOTES ON A SMALL COLLECTION OF MAMMALS FROM THE TANA RIVER, EAST AFRICA, WITH DESCRIPTIONS OF NEW SPECIES.

BY

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Curator of the Department of Mammals.

Mr. William Astor Chanler and Lieut. von Höhnel have recently sent to the Museum, among other East African collections, a small number of mammals. These were collected on the Tana River, between the coast and Hameye, a point about 300 miles from its mouth. Included among them is a new species of dormouse, *Eliomys*, which I propose to name *Eliomys parvus*. Its characters are as follows:

Eliomys parvus sp. nov.

Size small. Ears short, rounded, sparsely clothed with short, brownish hairs; the skin of the margin dusky.

Color above buff, tinged with brown. The hairs of the back are blackish in the basal half, then ringed with buff and tipped with brown. Muzzle lighter than the head, the short hairs being mostly without dark tips. A dusky line extends from the nostrils to the eyes, and a ring of dark color surrounds the latter. Cheeks (to the base of the ears), lips, chin, and throat clothed with hairs which are white to the base. The remainder of the under surfaces yellowish white, the hairs gray in the lower half. Feet white. Tail pale reddish chocolate-brown, washed with white, especially on the under side. Hairs of the tail short at its base, growing gradually longer distally, and attaining a length of 19^{mm} at the tip. The hairs are equally long on the median line and the sides of the tail, and hence there is no trace of a distichous arrangement.

Dimensions of body in millimeters.

	Cat. No. [illegible] ♀
Length of head and body	80.0
Length of tail vertebræ	69.0
Length of terminal hairs of tail	19.0
Length of hind foot, with claw	13.5
Height of ear from base of outer margin	9.0

Dimensions of skull in millimeters.

	Cat. No. [illegible] ♀
Basi-cranial length (anterior margin of foramen magnum to posterior base of incisors)	18.0
End of palate to posterior base of incisors	7.3
Length of nasals	8.0
Greatest zygomatic breadth	13.0
Upper premolar to posterior base of incisors	5.0
Length of upper molar series	2.8

This diminutive species closely resembles *E. kelleni* Reuvens, but appears to be slightly larger, with proportionately shorter tail. The ears are decidedly shorter. In *E. kelleni* all the hairs of the under surfaces are gray at the base, while in *E. parvus* those of the cheeks, chin, and neck are white throughout. The ears have a dark margin in the latter species, but in *E. kelleni* the hairs of the margin are white. The end of the tail is mostly white in *E. kelleni*, but not in *E. parvus*.

The type specimen of *E. parvus*, No. 21005, herein described, is a female. It was received in alcohol and afterwards made up as a dry skin. It was not accompanied by a label indicating the exact point on the Tana River where it was obtained.

The collection also contains two species of bats, belonging to the genera *Vesperugo* and *Nycteris*.

Vesperugo (Vesperus) rendalli Thomas.

There is a single specimen of this species, which was described by Mr. Thomas in 1889, from Bathurst, on the river Gambia.* It is a female of smaller size than the typical male specimen. Its dimensions are as follows, in millimeters:

	Cat. No. 21007 ♀
Head and body	41.5
Tail	33.5
Forearm	31.5
Head	15.0
Muzzle to eye	5.8
Ear, from base of outer margin to tip	12.0
Thumb, with claw	4.5
Lower leg	11.5

Nycteris hispida (Schreber).

Five specimens of this bat were collected, which differ in no way from those originally described. There are three males and two females.

Of mice, the collection contains but one species, which is allied to *Mus musculus*, and appears to be undescribed. Its characters are as follows:

Mus tana sp. nov.

Size larger than *Mus musculus*. Tail about one-fifth longer than the head and body, terete, scaly; with sparse hairs, which do not conceal the scales. Ears thin and rounded, rather sparsely clothed with short, stiff hairs. These are white on the margin of the ears and brown elsewhere.

General color brownish-gray above, hoary below; feet white. Fur soft, without spines.

Hairs of the back of two kinds, namely, long hairs, gray at the base and black distally, and shorter hairs, gray at the base, with a sub-

*Ann. and Mag. N. H., 6th ser., III, p. 362.

terminal ring of buff and a black tip. Both black and buff become gradually less conspicuous on the sides and fade into the white of the belly. Hairs of the belly gray at the base and white at the tip; on the throat they are entirely white. Fore and hind feet entirely white, the hairs longer than is usual in this group; those at the extremity of the toes extending beyond the claws, but not concealing them. Claws white. Soles naked, purplish-brown (in alcohol), including the tubercles, which are pitted and not striated. Scales of the tail, both above and below, dark brown; the hairs of the upper side dark brown, of the under side white.

Skull exactly comparable to that of *Mus musculus*, except in size. Teeth similar, but the anterior tubercles of the first lower molar when worn form a quatrefoil instead of a trefoil. Posterior lower molar triangular, the apex directly backward.

*Dimensions of the body in millimeters.**

	Cat. No $\frac{21004}{35884}$ ♀
Length of head and body	77.0
Length of tail vertebræ	93.0
Length of ear from lower margin of orifice to tip	16.5
Length of hind foot, with claw	23.0

Dimensions of the skull in millimeters.

	Cat. No. $\frac{35884}{21004}$
Basi-cranial length, from foramen magnum to posterior base of incisors	21.5
End of palate to posterior base of incisors	12.0
Length of upper molars	4.6
Length of nasals	11.0
Greatest zygomatic breadth	14.0
Length of lower molars	4.4

The type specimen, No. 21004, female, was received in alcohol. After being measured, it was made up as a dry skin. The exact locality on the Tana River in which it was obtained was not indicated.

Accompanying Mr. Chanler's collection was an immature specimen of *Nannomys*, apparently *N. minimus*, collected at Wange on Manda Island, north of Lama, by Mr. Gustav Denkhardt.

* From the alcoholic specimen before skinning.

REMARKS ON THE AVIAN GENUS MYIARCHUS, WITH SPECIAL REFERENCE TO M. YUCATANENSIS LAWRENCE.

BY

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Curator of the Department of Birds.

The discrimination and identification of the species and geographical races of the genus *Myiarchus* is one of the most difficult tasks with which the student of Neotropical ornithology has to deal, the style of their coloration being remarkably uniform, the species numerous, and their geographical variations perplexing. Some forms once considered specifically distinct, and indeed very different from one another when specimens from distant areas are compared, are connected by intermediate specimens where their respective ranges come together; in some cases (as for example that of *M. cinerascens* and *M. nuttingi*) it is not at all improbable that hybridism plays a part and thus complicates the problem; but in others (*e. g.*, *M. mexicanus* and *M. magister*) the intergradation is on too extensive a scale to warrant serious consideration of hybridism as the probable cause.

Most writers are agreed as to the limits of the genus, the only species involved in a difference of opinion regarding this point being the *M. barbirostris* (SW.), of Jamaica, which some of the best authorities have referred to the Antillean genus *Blacicus*, though I fail to discover wherein it differs structurally or otherwise (except specifically) from the flat-billed *Myiarchi* (*M. lawrencii* and allies). Doubt has been expressed by Messrs. SALVIN and GODMAN (*Biologia Centrali-Americana, Aves*, II, pt. 12, March, 1889, p. 96) as to the propriety of referring *M. flammulatus* LAWR. to the genus *Myiarchus*, and in this doubt I share so strongly that I have no hesitation in formally separating it. (See p. 606.) Another species also seems to me to require separation on account of its very long tarsi. This is the *M. magnirostris* (GRAY), of the Galapagos archipelago, a species which otherwise resembles the smaller flat-billed species, though differing in having the bill much narrower and less contracted at the tip. These two eliminations, together with that of the flat-billed group typified by *M. tuberculifer* and including *M. lawrencii* and allies, make four well-defined groups

included within the genus *Myiarchus*, as generally understood, the chief structural characters of which may be tabulated as follows:

a[1]. Bill nearly cylindrical, its depth at gonydeal angle nearly equal to its width at the same place...MYIARCHUS.
a[2]. Bill depressed, its depth at gonydeal angle decidedly less than its width at the same place.
b[1]. Nostrils distinctly lateral; width of bill at frontal feathers much less than length of gonys.
c[1] Tarsus much shorter than length of bill from rictus; lateral outlines of bill contracted at tip..ONYCHOPTERUS.
c[2]. Tarsus as long as bill from rictus; lateral outlines of bill not contracted at tip ....ERIBATES.
b[2]. Nostrils superior; width of bill at frontal feathers equal to length of gonys. (Tarsus much shorter than length of bill to rictus.).....DELTARHYNCHUS.

The synonymy of these generic or subgeneric groups is as follows:

1. Myiarchus Cabanis.

Myiarchus CAB., in Tschudi, Faun. Per., Aves, 1845, 152. Type, *Muscicapa ferox* GM.
Kaupornis BONAP., Ann. Sc. Nat., ser. iv, Zool., i, 1854, 133. Type, *Myiobius stolidus* GOSSE.
Myionax CAB. and HEINE, Mus. Hein., II, 1859, 73. Type, *Muscicapa crinita* LINN.
"*Despotina* KAUP, 1851," GRAY, Hand-l. I, 1871, 363. Type, *Muscicapa ferox* GM.

This section includes, besides the type (*M. ferox*), *M. crinitus* (Linn.), *M. mexicanus* (Kaup), *M. cinerascens* Lawr., *M. yucatanensis* Lawr., *M. tyrannulus* (Müll.), *M. phæocephalus* Scl., and all the West Indian species except *M. barbirostris* (Sw.), together with, as a matter of course, their various geographical races or subspecies.

2. Onychopterus Reichenbach.

Onychopterus REICH., Av. Syst. Nat., 1850, t. lxv. Type, *Tyrannus tuberculifer* D'ORB. and LAFR. (= *Myiarchus atriceps* CAB.?).

This includes, besides the type, *M. lawrencii* (Gir.) and *M. barbirostris* (Sw.), together with the various geographical races of and species allied to the former species.

3. Eribates Ridgway.

Eribates RIDGW., MS. Type, *Myiobius magnirostris* GRAY.

4. Deltarhynchus Ridgway.

Deltarhynchus RIDGW., MS. Type, *Myiarchus flammulatus* LAWR.

Species which I have not examined, and therefore can not assign to their proper sections, are the following: *M. cephalotes* Tacz., *M. pelzelni* Berl., *M. phæonotus* Salv. & Godm., *M. apicalis* Scl. & Salv., *M. tricolor* Pelz., *M. semirufus* Scl., and *M. inquietus* Salv. & Godm.

Myiarchus yucatanensis Lawr.

Although described by Mr. Lawrence in 1871 (Proc. Acad. Nat. Sci., Philad., 1871, p. 235), *Myiarchus yucatanensis* remained little known until 1887, when the present writer gave it definite characters in his

"Manual of North American Birds" (p. 334), based largely on a perfect specimen obtained in northern Yucatan by Mr. G. F. Gaumer; the extremely worn plumage of the type and the other specimen obtained with it by Dr. Schott having precluded a clear perception of the specific characters. The following year Dr. Sclater also recognized it as a distinct species and gave it (Cat. B. Brit. Mus., XIV, 1888, p. 260) a clear diagnosis, based on additional specimens collected by Mr. Gaumer. He also admitted its relationship to *M. stolidus* (Gosse), first indicated in the key of my "Manual," stating that it "clearly belongs to the Antillean group of *M. stolidus*, with broad rufous margins to the inner webs of the rectrices."

The next year Messrs Salvin and Godman (*Biologia Centrali-Americana, Aves*, II, pt. 11, March, 1889, p. 93) also recognized it as a species, but assigned it to the group of *M. lawrencii*, and qualified their opinion of its validity by the statement that they could "see very little difference between these Yucatan birds [*M. yucatanensis* Lawr.] and the form of *M. lawrencii* found in eastern Mexico, from Vera Cruz northwards," though admitting that "compared with *M. lawrencii* from more southern localities, including Yucatan itself,* the amount of red in the tail of *M. yucatanensis* becomes a more conspicuous character, and the difference between the two is more obvious."

More recently, Mr. J. A. Allen seems to be suspicious of its specific distinctness, and says (Bull. Am. Mus. Nat. Hist IV, No. 1, Art. xvii, Dec. 29, 1892, p. 345) that "the two original specimens * * * are both in very worn plumage, and were these the only specimens known I should not hesitate to refer them to *M. lawrencii*." He further says that "while the types bear a strong resemblance in coloration to worn specimens of *M. tyrannulus* [a South American species not referred to in my "Manual"] in which the amount of rufous in the tail is below the normal, this is evidently not the species to which they bear the closest affinity."

These somewhat conflicting views have induced me to reëxamine the subject, although the number of specimens of *M. yucatanensis* accessible to me has not increased since the "Manual" was written, except that the type, not then examined, has been borrowed for the purpose from the American Museum of Natural History. This reëxamination and comparison of specimens fully confirms my reference of the species to the typical section of the genus, as indicated in the "Manual" and indorsed by Dr. Sclater in the British Museum catalogue, the form of the bill in *M. yucatanensis* being very different from that of *M. lawrencii*.

For comparison with the three specimens of *M. yucatanensis* I have selected all the National Museum specimens of the *M. lawrencii* type from Yucatan (*M. l. olivascens*, nobis, four in number) and five examples

* These Yucatan birds are *M. lawrencii olivascens*, nobis, those from Vera Cruz northward being true *M. lawrencii*.

of true *M. lawrencii* representing localities "from Vera Cruz northwards," and including Giraud's type, said to have been obtained in Texas. That the differences between them are really very considerable, the following tabulated statement of their characters will show:

a^1. Bill approximately cylindrical (*i. e.* as in typical *Myiarchus*).

1. *M. yucatanensis.* Wing, not less than 3.35 (average, 3.38); tail, not less than 3.32 (average, 3.34); tarsus, 0.85; middle toe, 0.48; inner webs of second to fifth rectrices with inner half rufous; top of head distinctly more reddish brown than back.*

a^2. Bill distinctly depressed (*i. e.*, as in type-species of the subgenus *Onychopterus*).

2. *M. olivascens.* Wing, not more than 3.10 (average 2.97); tail, not more than 3.05 (average 2.87); tarsus, not more than 0.76 (average 0.74); middle toe, not more than 0.42 (average 0.39½); inner webs of second to fifth rectrices without any rufous in adult (a narrow edging only in young); top of head same color as back.
3. *M. lawrencii.* Wing, 3.22–3.35 (average 3.30); tail, 3.05–3.28 (average 3.15); tarsus, 0.75–0.80 (average 0.78); middle toe, 0.40–0.42 (average 0.41); inner webs of second to fifth rectrices merely edged with rufous; top of head distinctly darker (not more reddish) than back. (Colors throughout much darker than in *M. yucatanensis*, the upper surface of the tail more strongly washed with rusty, and wing-coverts edged with brown or rusty instead of light grayish.

* This character is of course obvious or conspicuous only in fresh plumage specimens.

ON A SMALL COLLECTION OF BIRDS FROM COSTA RICA.

BY

ROBERT RIDGWAY,

Curator of the Department of Birds.

The specimens referred to in the following notes were kindly submitted by the authorities of the Costa Rica National Museum, through Mr. George K. Cherrie, the ornithologist of that establishment.

1. **Rhodinocichla rosea** (Less.).

An adult female from Buenos Aires (No. 3660, Museo Nacional de Costa Rica, March 13, 1892, George K. Cherrie), is similar to 53900, U. S. National Museum, from Panama (J. McLeannan); but owing to its fresher condition the colors are rather purer, particularly the dark slate-color of the upper parts, which becomes browner with age. Its measurements are as follows: Length (skin), 6.60; wing, 3.20; tail, 3.15; exposed culmen, 0.79; tarsus, 1.07; middle toe, 0.72.

2. **Microcerculus luscinia** Salv.

An adult female from Burica, Costa Rica (No. 2593, Museo Nacional de Costa Rica, December 15, 1891, George K. Cherrie), is similar to No. 53901, U. S. National Museum, from Panama (J. McLeannan), but differs in the following particulars: There are no dusky terminal margins to the feathers of the upper surface; the innermost greater wing-coverts, on the other hand, have indistinct blackish tips; the general color of the wings, particularly the remiges, is appreciably darker; the middle portion of the lower breast and belly is much paler, inclining to dull brownish white, slightly tinged with rusty, each feather showing a central irregular (usually V-shaped) mark of dark grayish; the sides are more strongly tinged with raw-umber or tawny-olive. Length (skin), 4.00; wing, 2.15; tail, 0.87; exposed culmen, 0.60; tarsus, 0.87; middle toe, 0.60.

Some of the differences of coloration, as for example the darker hue of the wings and tail, and the stronger rusty tinge on sides, are doubtless due to the fresher condition of the plumage.

3. **Buthraupis cæruleigularis** Cherrie, sp. nov.

SP. CHAR.—Similar to *B. arcœi* Scl. and Salv., but larger, sides and flanks extensively and uniformly bluish dusky, and chin and throat dull indigo-blue, scarcely darker than top of head.

Adult male (type, No. 128840, U. S. Nat. Mus.,* Buena Vista, Costa Rica, August 4, 1892; Castro y Fernandez): Head (all round), hind neck, sides of neck, entire upper parts, sides, and flanks, uniform dull indigo-blue, the larger wing-coverts, remiges, and rectrices, however, dull black except on edges; chest and breast (except laterally), belly, anal region, and under tail-coverts bright yellow, changing gradually from rich Indian-yellow on the chest to lemon-yellow on the under tail-coverts; axillars canary-yellow; under wing-coverts mixed primrose-yellow and white; inner webs of remiges dull brownish gray, paler on edges, these becoming whitish toward base of quills; thighs uniform dusky indigo-blue. Bill entirely black; legs dusky horn-color; feet dull blackish. Length (skin), about 5.60 (tail imperfect); wing, 3.42; exposed culmen, 0.60; depth of bill at base, 0.35; tarsus, 0.85; middle toe, 0.60.

Mr. Cherrie sent an excellent description of this bird, but it has unfortunately been mislaid and I have therefore been obliged to prepare a new one.

Although apparently very different from *B. arcæi* Scl. and Salv. in the extensively and uniformly dusky sides and flanks, it is so closely similar in other features of coloration that I strongly suspect it may only represent an extreme variation of that species. At any rate, additional specimens will be necessary to establish its validity.

4. Tachyphonus rubrifrons Lawr.

Although Dr. Sclater considers this to be the female of *T. xanthopygius*, two of the three specimens now before me are marked as males by their collectors (J. Carmiol and N. Carranza).

The pair collected by Señor Carranza (Nos. 7168 and 7169, Museo Nacional de Costa Rica, Reventazón, Costa Rica, February 24, 1892), are almost exactly alike, and both very similar to No. 47454, U. S. National Museum, collected at Angostura, Costa Rica, January 8, 1867, by J. Carmiol. The two males differ from the female in the much stronger yellow tinge to the under tail-coverts, some of the middle feathers being, in fact, almost pure yellow, but no other difference of coloration is observable. The Carranza male differs from the Carmiol specimen in having the chin and throat purer gray, and the chest strongly tinged with yellowish olive.

If really referable to *T. xanthopygius*, the plumage represented by *T. rubrifrons* must, therefore, be that of the young male as well as the female.

According to the collector, the iris is reddish and the bill and feet black in both sexes.

* No. 8287, Museo Nacional de Costa Rica.

Measurements of the three specimens, together with a male of *T. xanthopygius*, are as follows:

TACHYPHONUS XANTHOPYGIUS Scl.

Museum No.	Museum.	Sex and age.	Locality.	Date.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
17875	U.S.	♂ ad.	Truando, Colombia	....	3.80	2.80	....	0.82	0.60

TACHYPHONUS RUBRIFRONS Lawr.

Museum No.	Museum.	Sex and age.	Locality.	Date.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
47454	U.S.	♂ ad.	Angostura, Costa Rica	Jan. 8, 1867	3.25	2.43	....	0.78	0.55
7169	C. R.	♂ ad.	Reventazón, Costa Rica	Feb. 24, 1892	3.25	2.43	0.63	0.80	0.52
7168	C. R.	♀ ad.	......do	....do	3.15	2.37	0.60	0.80	0.50

Should this bird prove to be distinct from *T. xanthopygius* Scl., as I believe it will, we must, if the A. O. U. canons of nomenclature are adhered to, restore the name *Tachyphonus rubrifrons* Lawr., for which Mr. Lawrence substituted the name *T. propinquus* when he discovered that the red color on the forehead of the type specimen was an accidental stain. (See Canon XXXI, A. O. U. Code of Nomenclature.)

5. Pachyrhamphus ornatus Cherrie. (Proc. U. S. Nat. Mus., XIV, No. 855, 1891, 338.)

An apparently immature female belonging to the Museo Nacional de Costa Rica (No. 1472, San José, J. C. Zeledon), is much like the type (an adult female), but differs in having the back, etc., more grayish olive-green, which, instead of being quite the same hue from upper back to tail-coverts is much tinged posteriorly with light sandy brown or fulvous, this being especially marked on lower and posterior scapulars and longer upper tail-coverts; the pileum is lighter, rather russet than chestnut; the broad pale margins to wing-coverts and secondaries are much paler, those of the coverts being chiefly buff, those of secondaries pale olive-buff; the sides of the head are paler, and the upper throat is nearly white, like chin. The white frontal mark is much less tinged with buff near base of culmen; the black patch covering nape and sides of occiput is less sharply defined and less intense black, and the adjacent color of hind neck is decidedly paler than the back, producing an indistinct collar. Length (skin), 5.50; wing, 2.85; tail, 2.20; exposed culmen, 0.42; tarsus, 0.70; middle toe, 0.45.

6. Pachyrhamphus cinereiventris Scl.

Four adult males in the collection of the Museo Nacional de Costa Rica are typical of this form, all having the whole back intense blue-black, without any gray across the hind neck. This is the case even in an immature male (same collection, No. 4432, May 3, 1890), in which the greater part of the rump is olive, instead of slate-gray, and the wings largely in immature plumage. The shade of color of under parts is very uniform (intermediate between slate-color and slate-gray),

some specimens showing a faint transverse freckling of a paler tint on the belly and other posterior portions.

Two immature females in the same collection differ from an adult (possibly a young male) in the collection of the U. S. National Museum from Greytown, Nicaragua (No. 40448, June 14, 1865, H. E. Holland), in the darker and richer color of the upper parts, the back being olive-brown in contrast with the olive-color of head and neck; wing markings rather deeper, especially the edges of secondaries; under parts considerably more richly colored, the prevailing hue being yellowish olive, clearing to olive-yellow on abdomen, under tail-coverts, etc., these parts in one specimen (No. 3465, Jiménez, August 12, 1889, A. Alfaro) being almost canary-yellow,* while the yellow covers nearly the whole anterior portion of the under surface.

7. **Platypsaris aglaiæ obscurus** Ridgw. (Proc. U. S. Nat. Mus., XIV, 1891, p. 474.)

An adult male (No. 5409, Museo Nacional de Costa Rica), obtained at the same time and place with the type of *P. a. obscurus*, is similar in color to the type on upper parts, but is paler beneath, especially on the throat, where there is not the slightest indication of the dusky spotting, so conspicuous a feature in the type. In fact, the whole throat, especially its lower portion, is considerably paler than any other part of the lower surface, except under tail-coverts and anal region, the color being a pale, slightly brownish, gray. The average hue of the under parts is very nearly the same as in the type of *P. a. hypophæus*,† and still more like another specimen of that form (No. 120294, U. S. Nat. Mus.). From all the males of the latter form, however, it may be distinguished by the decidedly smaller size, large white spot at base of inner web of outer primary, and correspondingly more extended white patch covering the basal portion of other primaries on the under surface. Measurements are as follows: Length (skin), 6.50; wing, 3.30; tail, 2.35; exposed culmen, 0.58; tarsus, 0.82; middle toe, 0.48.

Two additional females from the same locality agree essentially with the one originally described, and differ even more from the La Palma specimen doubtfully referred to *P. a. latirostris* (*cf.* Proc. U. S. Nat. Mus., XIV, 1891, p. 474). No. 5410 (Museo Nacional de Costa Rica), Jiménez, February 7, 1891, has the upper parts somewhat more intense chestnut-rufous, with none of the grayish-brown tinge seen on the back of the type female; the black of the pileum, however, is slightly mixed with dull rusty brown. The under parts are rather deeper ochraceous than in the type. Length (skin), 6.00; wing, 3.30; tail, 2.45; exposed culmen, 0.58; tarsus, 0.78. "Iris black; bill and feet, horn-color."

No. 3461 (Museo Nacional de Costa Rica), Jiménez, August 6, 1889, A. Alfaro, is still deeper in color, the upper parts tending more decidedly toward chestnut, and the lower surface quite uniform, deep

* This example is not sexed, and may be a young male.

† Proc. U. S. Nat. Mus. XIV, 1891, p. 467. (Interior of Honduras.)

ochraceous-buff, inclining to tawny along sides. There is no admixture of brown in the black of the pileum. Length (skin), 6.30; wing, 3.40; tail, 2.58; exposed culmen, 0.60; tarsus, 0.75.

The three females of this form which are now on view agree in the much brighter or more castaneous coloration of the upper parts, by which character they may be immediately separated from females of any other of the local forms of this species. In the clearness of this rusty coloring of the upper parts they come nearest *P. a. latirostris*, in which, however, the color is very much paler, while the pileum is dull slate-color instead of glossy black.

8. **Sclerurus canigularis** Ridgw. (Proc. U. S. Nat. Mus., XII, No. 762, February 5, 1890, 24.)

An immature female (No. 8281, Museo Nacional de Costa Rica, Buena Vista, Costa Rica, August 14, 1892, Castro y Fernandez) is closely similar to the type of the species (an adult female), but has the upper parts rather more castaneous and the chest a little less so. Its measurements are as follows: Length (skin), 5.70; wing, 3.40; tail, 2.35; exposed culmen, 0.80; tarsus, 0.88; middle toe, 0.72.

This bird is certainly distinct, at least subspecifically, from *S. albigularis* Scl.

9. **Scytalopus argentifrons** Ridgw. (Proc. U. S. Nat. Mus., XIV, No. 869, 1891, 475.)

Adult male (No. 6379, Museo Nacional de Costa Rica, Volcan de Irazú, July 31, 1891): Forehead and anterior half of crown (back to a little past posterior angle of eyes), delicate silvery gray or cinereous, this color extending backward laterally, above ear-coverts, to the hinder part of the occiput (terminating about half an inch from posterior angle of the eye); lores and anterior portion of the forehead a little darker and browner gray; orbital region nearly black, especially above the eye; postocular streak, occiput, hind part of crown, hind neck, back, scapulars, and wing-coverts uniform slate-black; remiges and rectrices similar but slightly browner; rump and upper tail-coverts dark bister-brown, barred with blackish. Ear-coverts, malar region, chin, and throat slate-gray (slightly darker on the first), gradually deepening on sides of breast to dark slate-color, the sides and belly dark slate-color, with broad pale gray tips, these light tips still paler, and less pure, gray on lower median portion of belly; flanks, anal region, and under tail-coverts dusky black, each feather broadly tipped with light russet or tawny-brown, producing a heavily barred effect. Bill entirely deep black; legs and feet rather dark horn-color, the outer side of the former considerably darker. Length (skin), 4.70; wing, 2.00; tail, 1.55; culmen (to base), 0.52; exposed culmen, 0.43; tarsus, 0.83; middle toe, 0.70.

This specimen differs from the type and the example which accompanied it (as described in these "Proceedings," Vol. XIV, pp. 475, 476), as follows: The frontal silvery patch is more extensive,* and exhibits

*Regarding the extent and shape of this patch in the original specimens due allowance should be made for their imperfect condition.

a conspicuous lateral extension, over the ear-coverts, quite as far as the end of the latter; the anterior part of the forehead and lores are paler, slightly brownish, gray instead of dark slate-color; the general color of the upper parts is devoid of any brownish tinge, being a pure slate-black or blackish slate, and the wings are without any trace of brownish markings; the side of the head, together with the chin and throat, are paler gray. Possibly the type may be a younger bird, and the other specimen (No. 5419, Museo Nacional de Costa Rica) may also be an immature male, or perhaps an adult female.

Young (?) female (No. 5952, Museo Nacional de Costa Rica, Volcan de Irazú, July 2, 1891): Above nearly uniform dusky brown (nearest "clove brown"), inclining to bistre posteriorly, where showing rather indistinct dusky central spots (a single subterminal one on each feather of hinder scapulars, lower back, and rump), the upper tail-coverts russet, with dusky bars; outer surface of remiges vandyke brown; sides of head a little paler than pileum, the ear-coverts nearly uniform dull slate-color; chin, throat, and chest mixed pale gray and pale isabella color, the latter on tips of feathers, and the prevailing color superficially; rest of under parts cinnamon-buff, deeper and brighter posteriorly, paler and grayer anteriorly, each feather marked with a partly exposed subterminal ∩-shaped mark of dusky; flanks, anal region, and under tail-coverts clear mummy-brown, rather broadly barred with dusky. Bill brownish black; legs and feet as in adult. Length (skin), 4.40; wing, 2.03; tail, 1.62; exposed culmen, 0.35; tarsus, 0.78; middle toe, 0.68.

10. Antrostomus saturatus Salvin. (*A. rufo-maculatus* Ridgw. Proc. U. S. Nat. Mus., XIV, 1891, 466.)

In redescribing this species as *A. rufo-maculatus*, I was not at the time aware of Mr. Salvin's previous name and description, my memoranda or references thereto having been somehow lost or mislaid. Since my attention has been called to the matter, I find there can be no question that I have thus, by accident, added a synonym to the nomenclature of this species.

Another adult male, from the same locality as the type, collected by Mr. Geo. K. Cherrie, July 24, 1891, has been received for examination. This example (No. 5893, Museo Nacional de Costa Rica) is almost exactly like the type, but differs in a few minor particulars, as follows: Along the sides of the occiput and across its posterior portion, some of the feathers have one or both webs mainly whitish, with black bars, producing a much interrupted series of irregular small whitish blotches; there is considerable light-colored (pale rusty buff) mottling on the scapulars and tertials, rendering the large black spots or blotches more conspicuous; the pale rusty-brown oblique bands on the middle tail-feathers are more interrupted, being much broken by irregular black markings, and there is even less light spotting on the throat, where the general color is an almost unbroken dusky black. Its measurements are as follows: Length (skin), 8.65; wing, 6.30; tail, 4.85; its graduation, 0.70; tarsus, 0.65; middle toe, 0.60.

NOTES ON A THIRD INSTALLMENT OF JAPANESE BIRDS IN THE SCIENCE COLLEGE MUSEUM, TOKYO, JAPAN, WITH DESCRIPTIONS OF NEW SPECIES.

BY

LEONHARD STEJNEGER.

The title of this paper explains the origin and *raison d'être* of the following remarks. For fuller explanation I would refer to the introductory note to the first paper of this series (Proc. U. S. Nat. Mus., XIV, No. 874, 1891, pp. 489–498). The second paper is entitled "Two Additions to the Japanese Avifauna, including Description of a New Species" (Proc. U. S. Nat. Mus., XV, No. 906, 1892, pp. 371–373).

The first paper made eight additions to the avifauna of Japan; the second two species; the third paper (the present one) also adds eight species to the list. An inspection of the material in the Science College Museum has consequently so far added eighteen species, several of which were hitherto undescribed. It has, moreover, resulted in clearing up many doubtful points and identifications, and I have had an opportunity to examine several rare species of which I had hitherto seen no Japanese specimens. For these and many other favors I wish to express my indebtedness to the authorities of the Science College Museum, particularly to Dr. I. Ijima.

Urinator pacificus (Lawr.).

A young specimen (No. 576; ♂; Tajiri, March 14, 1884) is in all probability referable to the present species. The dimensions are very small, particularly the bill, and as the bird is at least nine months old, the bill has probably attained full size.

This would make the second Japanese specimen of this species, the first one having been recorded by me but recently (Proc. U. S. Nat. Mus., XV, 1892, p. 291).

(64) **Gygis candida** (Gm.).

The exact identity of Blakiston and Pryer's No. 64 has been somewhat doubtful, though the probabilty that it was the present species was very strong. It is therefore interesting to learn from Dr. Ijima that Mr. Namiye has compared the specimen in question with the bird sent and found them to be identical, and as the latter bird is an unquestionable *Gygis candida* the doubt is set at rest. We are still igno-

rant, however, of the locality whence came the former specimen, but as the present specimen was collected in the Province of Owari the species must be admitted to the fauna. No reference to the White Tern is found in Seebohm's Birds of the Japanese Empire.

In a letter, dated February 13, 1893, Dr. Ijima informs me that he has since obtained another specimen, but he does not give any locality. It was found by Mr. Ota among a lot of skins brought to Yokohama from various places in Japan for export for millinery purposes. It is now No. 2337 of the Science College Museum and measures, according to Dr. Ijima, as follows: Bill, 33^{mm}; wing, 221^{mm}; tail, 97^{mm}; middle toe, with claw, 30^{mm}.

(75½) **Stercorarius pomarinus** (Temm.).

A young specimen (No. 1677), from the Province of Owari, is the third specimen from Japan and therefore well deserving of being recorded. It is a young bird.

(101) **Limosa lapponica baueri** (Naum.).

Dr. Ijima justly calls attention to the great dimensions of the specimen sent (No. 1144; Tokyo). The wing is only slightly in excess of the ordinary length in this species, being 230^{mm}, but the exposed culmen is 120^{mm}, and the tarsus 62^{mm}. He writes that he has had another specimen "of this form." Referring to the measurements given by me in my "Results of Ornithological Explorations in Kamchatka," etc. (Bull. U. S. Nat. Mus., No. 29, p. 123) it will be observed that all the sexed specimens are males. The difference in sex may account for the difference in size.

Tryngites subruficollis (Vieill.).

Specimen No. 2164, collected by Mr. Ota in the Province of Owari, adds not only a species, but a genus to the Japanese avifauna. The buff-breasted sandpiper is easily recognized by the peculiar pattern of the wing-feathers, best seen from the underside; the lining and axillars are pure white, but the under primary-coverts, as well as the inner webs of the remiges are beautifully marked with dusky marblings on a whitish ground.

The present species is strictly American in its distribution, though specimens have occasionally straggled to Europe, particularly England. On the other hand, Mr. E. W. Nelson (Cruise Corwin, 1881, p. 90) states that he found it quite common in the vicinity of Cape Wankarem, on the Arctic seacoast of eastern Siberia, early in August, 1881. It is not clear, however, that he actually collected specimens, at least there is no record corroborating the observation, that I know of. If such a colony occurs on the Siberian coast it is safe to say that the members composing it retrace their steps to America during the migrations, and the Japanese specimen can not be regarded otherwise than as an accidental straggler.

(1494½) **Gallicrex cinereus** (Gm.).

So far this species has only been obtained once in Japan, viz: a specimen collected by Mr. Ringer at Nagasaki, Kiu-Siu. We have now to record a specimen from Hondo, which was purchased in the flesh in Nagoya during the winter 1890–'91 by Mr. Narazaka, who is connected with the Educational Museum in that city. Dr. Ijima found it there and secured it for the Science College Museum in Tokyo (No. 2188).

Æstrelata hypoleuca Salvin.

The bird which last year (Proc. U. S. Nat. Mus., XIV, 1891, p. 490) I recorded as *Æstrelata leucoptera* is really the present species, and I hasten to correct the mistake.

I will say in my own defense, however, that the mistake was not due so much to a blunder on my part as to an unfortunate lack of type specimens of these difficult birds, and to various other circumstances, as will be seen from the following explanation: The specimens of alleged *Æ. leucoptera* with which the Japanese bird was compared were Peale's types of his *Æ. brevipes*, a name which everybody has considered synonymous with *Æ. leucoptera* of Gould. There were differences, but owing to the fact that there were still greater apparent differences between the Japanese bird and Mr. Salvin's diagnosis of *Æ. hypoleuca* I adopted the former name. But circumstances have changed since then, Mr. Witmer Stone having kindly undertaken to compare the specimens with Gould's types of *Æ. leucoptera* and Rev. Canon Tristram most generously lending me an authentically identified specimen of *Æ. torquata* (in Salvin's handwriting), the species with which Salvin compares it. Now it turns out that *Æ. torquata* is nothing else than *Æ. brevipes*, the species (under a wrong name) with which I compared it. It will be observed that Salvin says (Ibis., 1888, p. 359): "*Æ. torquatæ*, Macg., affinis, sed paulo major, cauda multo longiore distinguenda," while the difference in the tail-feathers as measured on my specimens only amounted to 10^{mm}.

Although the proportional differences are thus reduced to nothing, a careful observation shows that there are enough color characters to be relied upon, although not readily appreciated when reading the original description.

The differences as they now reveal themselves upon a comparison of the above material and an additional Japanese specimen mentioned below are as follows:

(1) In *Æ. brevipes* (*torquatus*) the lining of the wing is much whiter, only a broad margin along the anterior edge being slaty, while in *Æ. hypoleuca* most of the under primary coverts are lighter or darker gray.

(2) In *Æ. hypoleuca* all the tail-feathers, including the exterior pair, are uniform blackish slate, the concealed extreme bases being more or less white, while in *Æ. brevipes* the tail is much lighter gray, from slate color on the middle pair gradually becoming lighter toward the outer

pair, which are medium gray (Ridgway, Nomencl, pl. ii, no. 7), the outer pair, besides, more or less sprinkled with white in the inner web.

(3) In *Æ. hypoleuca* the slaty color of the top of the head extends considerably further down below and behind the eyes than in *Æ. brevipes* and the line of demarkation between the coloration of the upper and the lower sides is apparently less well defined.

As a rule, perhaps, the underside in *Æ. brevipes* is more or less sprinkled with dusky, especially on chest and flanks, but some specimens, at least, are fully as white below as *Æ. hypoleuca.*

In addition it may be well to call attention again to the white, hairy filaments found in all the three specimens of *Æ. brevipes* (*torquatus*) before me and absent in my specimens of *Æ. hypoleuca.* This may be a diagnostic character, or it may be simply seasonal and found in all species. It deserves a fuller investigation, however, than I can give it at present.

Æstrelata hypoleuca was originally introduced by Seebohm into the Japanese avifauna upon the strength of specimens collected by Mr. Holst in the Bonin Islands (Ibis, 1890, p. 105). I have now before me another specimen from the Bonins, collected by Mr. B. Nakamura in 1892 (Sc. Coll. No. 2290), as well as the specimen from the Province of Mino, Hondo, at the time referred to by me as *Æ. leucoptera.*

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-f.	Exp. culmen.	Graduation of tail.	Tarsus.	Middle toe, with claw.
Sc. Coll. 450 ..	....	ad ..	Prov. Mino, Hondo.	1885	227	112	24	41	30	38
Sc. Coll. 2290 .	Nakamura	ad ..	Bonin Islands..	1892	231	123	27	42	33	41

Æstrelata longirostris, sp. nov.

Diagnosis.—Length of nasal tube more than one-fourth the exposed culmen; a white wedge on inner webs of primaries occupying the basal two-thirds; back, plumbeous; top of head, hind neck, slaty black; feathers of rump and upper tail-coverts abruptly white at base; tail-feathers, slate color, white at extreme base, and outer pair strongly sprinkled with white on inner webb; entire underside pure white, including lining of wing, except a narrow line along the anterior edge, which is white and black mixed.

Habitat.—North Pacific Ocean: Province of Mutsu, Japan.

Type.—Sc. Coll. Mus. Tokyo, No. 1583.

This species differs from all the other true *Æstrelatæ* in its *proportionally* long and slender bill, approaching in this respect *Cookilaria cookii,* in which, however, the nasal tubes are very much shorter.

As will be seen from the measurements given below, it is one of the small species of the genus belonging to the section with large white wedge on the inner web of primaries. It consequently at once differs from

Æ. hypoleuca Salv. and *Æ. brevipes* Peale, which latter I consider the same as MacGillivray's *Æ. torquata.** Of the smaller *Æstrelatæ* with white wedge on the inner web of primaries it needs only comparison with *Æ. defilippiana* and *Æ. leucoptera*. It differs from the latter by the greater amount of white on the under wing-coverts (agreeing in this respect almost absolutely with *Æ. defilippiana* as exemplified by specimen No. 9961, kindly lent me by Rev. Canon Tristram), by the plumbeous color of the back, and by the different coloration of the tail-feathers. From *Æ. defilippiana*, on the other hand, it differs, among other things, sufficiently in having the top of head and nape blackish, like the small upper wing-coverts, and not ashy like the rest of the upper surface. I may add that the characters of *Æ. leucoptera*, as now understood by me, are furnished me from Gould's types in the Philadelphia Academy of Sciences by Mr. Witmer Stone, who also had the kindness to directly compare them with the present species.

I know of no other species with which *Æ. longirostris* needs comparison.

It is one of the most interesting recent additions to the fauna of Japan, or, more properly, to that of the North Pacific Ocean, as the province of Mutsu, whence came the two specimens here noticed, can

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*As Peale's *Æ. brevipes* has heretofore always figured among the synonyms of *Æ. leucoptera* (*Æ. cookii* Auct. *nec* Gray), a few remarks may not be out of place. The material before me consists of Peale's two specimens and Canon Tristram's No. 9779 (♂ ad. Muanivake, interior of Viti Levu; T. Kleinschmidt coll. May, 1878), labeled *Æ. torquata* in Mr. Salvin's handwriting, and kindly lent me by the owner. The latter specimen, it is true, is not one of the types, but it agrees so closely with the descriptions published that I feel confident of its correct identification. This being the case I have no hesitation in pronouncing *Æ. torquata* a synonym of *Æ. brevipes*, for the three specimens are as much alike as any three specimens of *Æstrelata* I have seen. They differ from *Æ. leucoptera* by having the back plumbeous and by having the wedge in the inner web of primaries ill-defined gray instead of well-defined white. As Peale's two specimens served Mr. Cassin as basis for his *Procellaria cookii* and Mr. Ridgway for his *Æ. leucoptera* the synonymy of the present species would stand thus:

Æstrelata brevipes (Peale).

1848.—*Procellaria brevipes* Peale, Zoöl. Expl. Exp., Birds, (p. 294).

1858.—*Procellaria cookii* Cassin, U. S. Expl. Exp. Mamm. and Orn., p. 414 (*nec* Gray; *nec* Gould).

1860.—*Procellaria torquata* MacGillivray, Zoöl., XVIII, p. 7133.

1863.—*Procellaria desolata* Schlegel, Mus. P. Bas., Proc., p. 13 (*part; nec* Gmel).

1871.—?*Fulmarus aneiteimensis* Gray, Hand-l. B., III, p. 107 (*nom, nud.; fide* Salvin. Gray, however, quotes MacGillivray's *torquata loc. cit.*, p. 1104).

1887.—*Æstrelata leucoptera* Ridgway, Man. N. Am. B., p. 65 (*nec* Gould).

I may mention a character found in all three specimens by me referred to *Æ. brevipes*, viz., numerous hair like white filaments on occiput, hind neck, and sides of neck. These filaments I have been unable to observe in any other *Æstrelata* in our collection, but Mr. Witmer Stone, who kindly examined and compared some of my specimens with Gould's types in the museum of the Philadelphia Academy, informs me that similar filaments are present in the uniform dusky specimen which Gould considered the young of his *Æ. mollis*.

hardly be regarded as their true home. *Æ. longirostris* probably breeds on some out-of-the-way islet in the North Pacific, and the specimens in question, whose wing-feathers are molting, were most likely driven from their regular habitat by a heavy gale. The discovery of this species affords an interesting parallel to that of *Æstrelata fisheri*, described not many years ago by Mr. Ridgway from Kadiak, Alaska.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Wing.	Tail feathers.	Exposed culmen.	Tube.	Tarsus.	Middle toe with claw.	Grade of tail.	Remarks.
Sc. Coll. Tok., 1584	....	Ad	Prov. Mutsu, Hondo.	200*	103	25	7	28	33	23	
Sc. Coll. Tok., 1583	....	Ad	....do..............	187*	98	25	7	29	36	20	Type.

* Longest primaries molting.

Bulweria bulweri (Jard. and Selby).

The specimen (No. 452) referred to in the previous account (Proc. U. S. Nat. Mus., XIV, 1891, No. 874) as having been "picked up on the shore of Sulphur Island" is now before me. Like the other Pacific specimens examined by me, it has the light wing bar. By Canon Tristram's courtesy I have been able to compare our specimens with the one in his collection from the Marquesas Islands and referred to *B. macgillivrayi* (Tristram, Cat. Coll., 1889, p. 6). I must regard it as typical *B. bulweri*, for it has the wing bar very conspicuous, and I fail entirely to understand the remark in the Ibis, 1881, p. 252.

Oceanodroma fuliginosa (Gm.).

In introducing this interesting addition to the Japanese avifauna I have at once to state that this is neither Kuhl's, nor Forster's, nor Solander's, nor Parkinson's *Procellaria fuliginosa*.

It is with great reluctance that I adopt "this much abused specific name, the various applications of which in this family of birds are hard indeed to trace, and harder still to remember," as Salvin truly says (Rowley's Orn. Misc., I, 1876, p. 232), but I see no other alternative. The matter stands thus: The present specimen certainly does not belong to any of the species now recognized by ornithologists. I should, therefore, have felt but little hesitation in describing it as new, were it not that Latham's (and consequently also Gmelin's) description fits the bird exactly. The case is in many respects parallel to that of Gmelin's *P. desolata*, a specific name almost as "much abused" as *P. fuliginosa*. Both having been misapplied by Kuhl, an *Æstrelata* was for many years known as *Æ. desolata*. Of late, however, Latham and Gmelin's

description and name have been applied to *Prion desolatus*. So far the parallel is absolute. The only difference is that Latham's description of *P. desolata* does not fit the *Prion* half as well as his description of *P. fuliginosa* does the present species. Therefore, if it is defensible and correct to recognize a *Prion desolatus* Gmel. *nec* Kuhl (and I believe it is), then it also becomes necessary to recognize the bird before me as *Oceanodroma fuliginosa* Gmel. *nec* Kuhl.

The present specimen is strongly suffused with plumbeous above, but this plumbeous tinge is probably present in all the uniform fuliginous species, when fresh, and will probably in time disappear in this specimen, too. It is chiefly distinguishable from the other similarly colored species by its large size.

The specimen (Science College Museum, No. 1555) was collected by Mr. Y. Tanaka at Torishima, 1891, and by him presented to that museum.

Oceanodroma markhami (Salv.).

Through the great kindness of Canon Tristram I have before me the specimen from Sendai Bay, collected by Lieut. Gunn in 1874, which has caused the introduction of the name *O. melania* into the Japanese avifauna. I have also before me U. S. Nat. Mus. No. 13025, the *O. melania* collected by Xantus, at Cape St. Lucas (entirely overlooked by Seebohm, B. Jap. Emp., p. 271), and the only specimen thus far obtained in North America besides the type. The coloration of the two specimens is practically identical (the uniform brown upper surface, without plumbeous tinge of the National Musueum bird, I attribute to the age of the specimen), but the proportions are so different that I feel compelled to regard them as belonging to different species. The question now arises, which one is the true *O. melania* of Bonaparte? Seebohm has compared Tristram's bird with the type in Paris, and says, in a general way, that he has "no doubt that they belong to the same species" (B. Jap. Emp., p. 271). On the other hand, I find on the back of the label of the Cape St. Lucas specimen, in Dr. E. Coues's handwriting, the following: "True *melania*, as ascertained by measurements procured from Pucheran by Prof. Baird." Now, if Seebohm has not minutely noted the various dimensions and found them identical, he would naturally have no doubt as to the identity of the two specimens, if depending chiefly on coloration. Under these circumstances I think it safer to rely upon the measurements of the type given by Pucheran, and to regard the two Mexican birds, the type and the specimen in the National Museum, as being the same—consequently true *O. melania*.

The Japanese bird, on the other hand, agrees very well with Salvin's *O. markhami*. It will be observed in the table of dimensions given below that the chief difference between the Mexican and the Japanese birds is in the length of the tarsus, and we are at once reminded of Salvin's remark in regard to this *O. markhami* (P. Z. S., 1883, p. 430): "*C. melaniæ*, Bp. apud Coues, certe similis, sed capite plumbescente,

tarsis brevioribus forsan diversa." I feel, consequently, confident that there can be but very little, if any, difference between the type of *O. markhami* and the Japanese so-called *O. melania*.

It may be interesting to remark that this species (or possibly *O. fuliginosa*) has been recorded from Japanese waters long ago, as v. Kittlitz (Denkw., II, p. 191) obtained, in lat. 37° N., long. 211½° W., Gr., a specimen of a bird which he describes as a *Thalassidroma*, rather large and "uniformly blackish brown."

Oceanodroma monorhis (Swinh.).

Although not strictly an addition to the Japanese avifauna, as I have already included the species in my list of the birds of the Liu Kiu Islands (Proc. U. S. Nat. Mus., x, 1887, p. 414) upon the authority of Collingwood (P. Z. S., 1871, p. 422), the present specimen is highly interesting as being the first one obtained in Japan proper. It was collected by Mr. N. Ota in the province of Mutsu, and is now No. 1598 of the Science College Museum. The specimen was taken to England by Canon Tristram, who identified it as above. It agrees very well with Swinhoe's original description (*Ibis*, 1867, p. 386), and I have no doubt as to the correctness of the identification, although I can not verify the character which to Swinhoe suggested the specific name, and which he describes in the following words: "Nostril with only one hole apparent at the end of the tube." In the present specimen the septum is certainly present and visible, though perhaps not reaching as far forward as in the other species.

Ciconia nigra (Lin.).

In my review of the Japanese Herodii (Proc. U. S. Nat. Mus., 1887, p. 285) I gave the characters and the synonymy of the present species "in order to facilitate the identification if any straggler should visit Japanese territory." The straggler has now done so, and the brackets which included the name of the species in my synopsis may be removed, as I have before me, through Dr. Ijima's kindness, an immature female Black Stork, shot by Messrs. Ise Jogoro and Ohashi (and presented to the Science College Museum by the former) on January 19, 1892, at Sunamura, at the mouth of Nakagawa, near Tokyo, where the bird had been observed among the rushes for about a week previously.

Being a young bird, the feathers of head and neck are dark brown with lighter margins and no metallic green reflections.

(137½) **Demiegretta ringeri** Stejn.

The collection contains two specimens, one (No. 426) from Sakura, Shimosa, March 14, 1884, the first record from Hondo, but not in full plumage and consequently unavailable for comparison; the other from Tsushima, are of the specimens upon which Dr. Ijima based his remarks (Journ. Sc. Coll. Imp. Univ. Japan, v, 1891, p. 122) to the effect that

he failed to see the distinction between the color of the occipital crest and the rest of the upper plumage, except the scapular plumes, and that consequently he refers to the specimens under the name of "*Ardea*" *jugularis* Wagler.

To this I may remark that in the specimen sent nearly all that is seen of the back, on account of the make of the skin, consists of the scapular plumes. If the elongated occipitals, however, be compared with the feathers of the hind neck no one can fail to appreciate the distinction in color. The top of the head and the occipital crest in the specimen before me (No. 1802) are beautifully plumbeous, "while in the Polynesian specimens the top of head and the occipital crest are much darker, corresponding closely to Ridgway's 'slate black.'"

I must therefore contend that Dr. Ijima's Tsushima specimen, so far from weakening the status of *Demiegretta ringeri*, has materially strengthened it.

Phasianus torquatus (Gmel.).

A specimen from Tsushima (Sc. Coll. Mus. No. 1775) was sent in order to have it compared with "continental" specimens. It agrees in every particular with other specimens collected by P. L. Jouy in Tsushima, now in the U. S. National Museum, as well as with specimens from Fusan, Korea, collected by the same gentleman. Of Chinese specimens I have only two specimens procured in the Shanghai market, but without information as to exact locality. From these the Korean and Tsushima birds differ in the greater amount of chestnut on the interscapulium. Seebohm (*Ibis*, 1888, pp. 313, 314) in a very general way hints at local differences of coloration in *Ph. torquatus*, but fails to establish any races. With a less extensive material I do not feel justified in separating the Korean birds.

(157) **Coturnix coturnix japonica** (Temm. & Schl.).

In regard to the Japanese quails, I am inclined to make Mr. Seebohm's words mine, viz, "I do not believe in the two quails." (Trans. As. Soc. Jap., x, 1882, p. 128.) The pattern and ground color of the throat in the European quail is very variable indeed, and the Japanese subspecies is no exception, as the material before me shows, in which I can trace all gradations from white-throated birds to those with a uniform dark vinaceous-cinnamon throat.

One of the two birds sent by Dr. Ijima is particularly instructive, as it shows a phase of the throat coloration of the Japanese bird not yet recorded. No. 2168, from the Province of Owari, is an old male in the normal breeding plumage, *i. e.*, with the whole throat and sides of face uniform dark vinaceous-cinnamon, in every respect identical with a male collected by Capt. Blakiston at Sapporo, Yezo, May 11, 1877 (U. S. Nat. Mus., No. 95980). The other specimen (No. 2170), from the same locality, differs, however, in having a large black patch down the middle of the throat, sending off at the lower end on each side the usual

upper cross branch; otherwise the throat and sides of face are as uniformly saturated vinaceous-cinnamon as the other specimen. In addition, No. 2170 differs from the other Japanese specimens before me in having the elongated flank-feathers less chestnut and with a broad blackish edge along the whitish central stripe in these feathers.

In the first-mentioned example there is just the faintest possible trace of dusky on the middle of the throat as an indication of the black patch, and, moreover, near the chin there is a small white feather left. I am, therefore strongly inclined to the belief that the vinaceous-cinnamon throat is derived in spring from the white throat by recolorescens.

(158) **Columba intermedia** Strickl.

A young bird (No. 139) undoubtedly belonging to this species and collected at Kurikomayama, Miyagi-ken, northeastern Hondo, on March 28, 1884, apparently disposes of the so-called *C. domestica* (or *livia*) in Japan (Proc. U. S. Nat. Mus., 1887, p. 424). The probability was certainly against the latter occuring in Japan, but without any specimen of *C. intermedia* from Japan proper at hand I regarded it as the safe course to retain the name and give the distinguishing characters of both species.

The species with white tail-band is not so easily disposed of however, and as it occurs in Korea it may be looked for in Southern Japan.*

(315) **Butastur indicus** (Gmel.).

Blakiston and Pryer (Trans. As. Soc. Jap., x, 1882, p. 183) record the Javan buzzard as common in Yamato and Shikoku, but "as yet not found north of Yokohama." Sc. Coll., Mus. No. 1678, is therefore noteworthy as having been obtained at Nikko, about 80 miles north of Yokohama.

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* In my review of the Japanese pigeons (Proc. U. S. Nat. Mus., 1887, p. 425), I referred to this bird as *Columba rupestris* (Pall.), at the same time calling attention to Taczanowski's statement as to the difference between the typical birds from Dauria and Baical and those from Ussuri, the Russian province just north of Korea. I had not seen specimens of either form then, but our museum having since obtained specimens of both I am in a position to fully corroborate Taczanowski's observation, and feel prepared to carry out his suggestion (Bull. Soc. Zool., France, 1876, p. 240) that the eastern form should be separated, if additional specimens should present the same result as he had reached. I propose to call it

Columba taczanowskii, sp. nov.

Diagnosis.—Similar to *C. rupestris* (*i. e.*, with white wing and tail-band), but the gray color darker, the entire breast strongly suffused with wine-purple, with a strong metallic gloss, which in certain lights changes to green; neck all around verdigris green with metallic gloss, which in certain lights changes to purplish.

Habitat.—Korea, Ussuri, and probably Northern China.

Type.—U. S. Nat. Mus., No. 114582; ♂ ad.; Southern Korea, November 22, 1882; P. L. Jouy, Coll. No. 1328.

Accipiter pallens, sp. nov.

Diagnosis.—Adult female, similar to *Accipiter nisus*, but upper surface much lighter and grayer, being a light gray (about averaging like Ridgway's gray, no. 8, pl. ii, Nom. Col.).

Habitat.—Japan.

Type.—Science College Museum No. 2192; Prov. Hitachi, Japan; Jan., 1892.

With an abundant material of sparrow hawks (*A. nisus*) from the British Islands, the continent of Europe, India, Korea, and Japan, consequently covering the entire west-to-east range of that species, I can discover no approach to a coloring of the upper parts such as the present bird shows; nor can I find in the very extensive literature on the variations of *Accipiter nisus* any reference to a similar specimen.* Taking a large series of specimens of the corresponding age and sex, there is but slight difference in the coloration of the upper parts, and in the series before me, ranging from England in the west, to Japan in the east, it is impossible to pick out any specimens showing a decided difference from the average.

The bird, however, which I have ventured to give a new specific name is not one but several shades lighter and grayer than the ordinary *A. nisus*, grading from Ridgway's gray No. 7 (Nom. Col., pl. ii) on top of the head to No. 9 on the upper tail-coverts. In addition the shaft-streaks are very dark and pronounced; the dark bands on the tail are nearly obsolete; and the white band at the end of the tail is very broad and conspicuous, being fully 5^{mm} wide. The under side is also lighter, the dark crossbars being decidedly gray. In size, proportions, and pattern of coloration there is no difference.

Without seeing the specimen some ornithologists might perhaps think that the paleness and grayness of this specimen is due to fading or abrasion. But that is not the case. The plumage is quite new and fresh. Nor is there any apparent tendency to albinism; the concealed white spots are not abnormally large; and there are hardly any white margins to the upper wing-coverts or tail-coverts so common in specimens of *A. nisus*. The specimen is undoubtedly old, but age alone is hardly a sufficient explanation of the fine coloration so markedly different from all other specimens of *A. nisus*. Others might insist that we have here to do only with an accidental individual variation, but I would quote what Dr. Ijima writes me *apropos* of this bird: "Sparrow-hawks of this color are known (though rare) to Japanese falconers and are prized much more by them than the ordinary ones, as they are said to be more powerful and useful."

It would be hard to believe this bird to be a resident of Japan, together with the ordinary *A. nisus* which is common there, but as the

* See, however, reference at end of this article.

specimen in question was shot in January there is every reason to suppose that it only visits the country during migration. I would then suggest the possibility that this light-gray form may be the bird breeding in Kamtschatka, where we know that the place of *Accipiter palumbarius* is taken by the nearly white *A. candidissimus*. True, the Kamtschatkan birds are said by Taczanowski to be similar to those from Europe (Bull. Soc. Zool., France, 1883, p. 332), but this identification can hardly be considered conclusive, as in the same breath he determined the *A. candidissimus* as *A. atricapillus*. It is more than likely that younger birds of *A. pallens* and of *A. nisus* may be difficult to identify, except by the most minute comparison, and it is not likely that the difference would reveal itself unless he had old birds of both species before him.

Since the above was written the first volume of Dr. Taczanowski's posthumous work "Faune Ornithologique de la Sibérie Orientale," has been received, and to my delight I find my views strongly corroborated on p. 107, where he describes "un mâle adulte du Kamtschatka" as having "le cendré bleuâtre des parties supérieures du corps beaucoup plus clair que dans les oiseaux de la Sibérie orientale et de l'Europe centrale avec lesquels nous l'avons comparé, la couleur du sommet de la tête, qui est plus foncée que sur le reste, est beaucoup moins foncée que celle de la région interscapulaire des oiseaux cités, le cendré bleuâtre est le plus clair sur les scapulaires postérieurs, les remiges tertiaires, le croupion et sur la queue, les baguettes noires sont partout bien dessinées . . . . . . la bordure terminale des rectrices largement blanche."

Syrnium uralense (Pallas).

A specimen from Hanno, province of Musashi (November 10, 1883), Sc. Coll. Mus., No. 629, brings up the old question as to the status of this form in Japan. Four specimens from Yezo, one collected by Blakiston and three by Henson, are apparently true *S. uralense*. I say apparently, because I have a suspicion that the Japanese birds are very much smaller than the continental—especially European—specimens, but as I am somewhat doubtful in regard to the sexing of the specimens before me I do not venture to separate them.

Two specimens from Hondo, including the present specimen, are perceptibly darker than the Yezo birds, so much so in fact, that I am inclined to regard them as a separable race. However, they are much nearer to the northern than to the dark one from Nagasaki.

Against the acceptance of three forms, viz, (1) a *S. fuscescens* from Kiu-Siu, (2) the very light true *S. uralense* from Yezo, and (3) a darker race of the latter possibly entitled to a trinominal appellation from Hondo, there is only the dark specimen, in the Pryer collection, said to come from Yokohama. This occurrence seems so improbable that I wish to challenge the accuracy of the label, a challenge the more justifiable as I have most direct information to the effect that Mr.

Pryer did not always exercise that scrupulous care and promptness in labeling his specimens which alone would entitle them to weight as evidence in doubtful cases.

(165) **Cuculus kelungensis** Swinh.

A young specimen which can only have been out of the nest but a short time is exceedingly interesting, as it demonstrates how far apart *C. kelungensis* and *C. canorus* in reality are, in spite of the superficial resemblance of the adult birds.

The specimen (Tokyo Univ. Mus., No. 1950), which was collected by Dr. Ijima at Norikura, July 18, 1891, may be described briefly as being uniformly slate above, with a faint olive gloss on back and wings, and more plumbeous on rump and upper tail-coverts, every feather very narrowly fringed with white at tip, a few white feathers on nape; sides of face, throat, fore-neck, and chest solid blackish, rest of lower surface blackish, with white crossbars.

It will be seen how different this blackish bird is from the young of the European cuckoo (and presumably from that of its Eastern representative *C. c. telephonus*, an adult specimen of which was shot in the same locality), a difference fully as large, if not larger, than that between the young of *Dryobates major* and *japonicus*.

The specific distinction between *C. kelungensis* and *canorus*, therefore, seems to be considerably deeper-rooted than the difference in their note and the comparatively slight, though quite constant difference in ground color and pattern, between the adults would indicate.

The correctness of referring this specimen to the present species can not be doubted, as there is no probability that the young of *C. telephonus* is so different from its Western relative. On the other hand the dimensions, which in this half-grown bird are greatly in excess of those of the full-grown *C. tamsuicus*, preclude its being referred to the latter species.

(178) **Eurystomus calonyx** Sharpe.

The birds of this form are of very great interest, as the only specimen hitherto obtained in Japan proper is the specimen, often referred to, which was procured at Nagasaki in May, 1879.

As the specimens (which were collected and donated by Mr. W. Takachiho at Hokosan, Buzen, Kiu-Siu, May 25, 1891), were carrying branches for the nest in the hole of a big tree it is safe to assume that the bird is a regular summer resident in the southern portion of the country as it has already been shown to be in Tsushima.

A comparison of these two birds and four from Tsushima collected by Mr. P. L. Jouy in June, 1885, with others from various localities, fully bear out the distinctions made by Mr. R. B. Sharpe (P. Z. S., 1890, pp. 550–551). At the same time a reëxamination of the Liu Kiu specimens previously referred to by me as *E. orientalis* proves this identification

to be correct, as it agrees in every particular with the Philippine Islands specimens.

We have, consequently, in Japanese territory two species, or forms, of *Eurystomus*—*E. orientalis* in the Liu Kius, probably traveling south over Formosa to the Philippines, and *E. calonyx*, the migrating route of which is more westerly over China to the Malayan peninsula.

This shows how essential it is not to disregard the small differences and fine distinctions, if we wish to come to a full understanding of the many difficult questions for the solution of which we study ornithology. The naming and distinguishing of these forms is not the ultimate object of our study, but is the necessary and only means by which we can arrive at the truth.

(169) **Upupa epops** Lin.

A specimen (No. 1570) from Yamadagori, Province of Ise, and obtained from Mr. Ota, agrees perfectly with European and Asiatic specimens.

The Hoopoe is probably not so rare in Japan as one might be led to suppose from the statement in Seebohm's Birds of the Japanese Empire, p. 159, that "the sole claim of the Hoopoe to be regarded as a Japanese bird rests upon a single example in the possession of Captain Blakiston [now U. S. National Museum No. 96009], which was obtained off the southeast coast of Yezzo," for not only was it mentioned in Fauna Japonica from a Japanese drawing, but Prof. Maximowitch, who could not well have mistaken the bird, noted it as having been seen at Hakodate in 1861 (Blakiston, Ibis, 1862, p. 138; Blak. and Pryer, Trans. As. Soc. Jap., x, 1882, p. 138). The U. S. National Museum, moreover, has received from Mr. Ringer a male specimen (No. 114759) which was collected in Kiu Siu on March 8th, 1888, and now Dr. Ijima writes me that Mr. Nozawa has shot it at or near Sapporo, Yezo. We have thus positive evidence of its occurrence on all three of the large islands. Since the above was written Dr. Ijima informs me (Feb. 13, 1893) that Mr. Alan Owston, of Yokohama, had just shown him a specimen said to have come from Nagoya.

(170) **Yungipicus kizuki** (Temm.).

When first advocating the restriction of the name *Y. seebohmi* to the Yezo bird and arguing in favor of regarding the Hondo bird as typical *Y. kizuki*, I had only 9 specimens at hand. The material at my disposal has increased considerably since then, and after examining the 22 Japanese specimens now before me I can only re-affirm what I said then (Proc. U. S. Nat. Mus., 1886, p. 122) viz, "that the form which inhabits the middle Island [Hondo] is inseparable from the Nagasaki bird and that the birds south of 'Blakiston's Line' are more different from the Yezo bird than are Yokohama and Nagasaki specimens from each other."

Messrs. Hargitt and Seebohm, who originally held that *Y. kizuki* is

confined to Kiusiu and *Y. seebohmi* to Hondo and Yezo, have of late modified their views somewhat, inasmuch as both forms inhabit Hondo; but their arguments are by no means clear and are altogether unconvincing. Mr. Seebohm (B. Jap. Emp., 1890, p. 157) says: "All my Yokohama examples (eight), including a breeding female, agree in color and markings with the skin from Yezzo [*Y. seebohmi*], and not with that from Nagasaki" [*Y. kizuki*], but on the previous page he distinctly contradicts himself by saying that he has two examples of the typical form, *i. e.*, *Y. kizuki*, collected by Mr. Owston at Yokohama, and one by Mr. Heywood Jones on Fuji-yama, which is only 42 miles distant from Yokohama. Mr. Hargitt, on the other hand (Cat. B. Brit. Mus. XVIII, 1890, p.319), makes me responsible for the theory of both forms inhabiting the same island.* In my original article referred to, I expressly stated (p. 120) that, "in order to find out the true habitat of a Woodpecker it is necessary to ascertain where it breeds," and for the possible occurrence of *Y. seebohmi* in Hondo I suggested (p. 123) that it might straggle across in winter from Yezo. I have later suggested the possibility of true *Y. seebohmi* occurring in very high altitudes in northern Hondo, but that is hardly more than a guess and should not be quoted otherwise.

But the statements in regard to these forms have become still more conflicting of late, for while Mr. Seebohm has referred the Tsushima bird to *Y. seebohmi* (Ibis, 1892, p. 95), Dr. Ijima (Journ. Coll. Sc., V, 1891, p. 121) says that "the typical form [*Y. kizuki*] found on the Hondo also occurs on Tsushima". He has kindly sent me a skin from the latter island (No. 1760; ♀ ad. Niimura, Tsushima, March 16, 1891, M. Namiye coll. In addition to this I have two adult females (U. S. Nat. Mus. No. 114636 and 114637) collected by Mr. Jouy in Tsushima, May 18 and June 2, 1885, respectively. Comparing these three specimens point for point with three specimens from Kiu Siu I can fully corroborate the correctness of Dr. Ijima's identification, for the Tsushima birds. Lest I might be accused of partiality I mixed the birds together and asked my friend Robert Ridgway to pick out the three darkest specimens without giving him any information as to their habitat or anything else. He at once picked out two, but had great difficulty in making up his mind which of the remaining four was the darkest. When he finally decided, it was found that he had selected as the *darkest* the three Tsushima birds! Yes, the Tsushima birds are, if any, darker, that is, they are even more *Y. kizuki*, than the typical Kiu Siu birds themselves, and yet Mr. Seebohm calls them *Y. seebohmi!!*

As Dr. Ijima also states, the Sagami (Hondo) birds agree in color and markings with the typical *Y. kizuki*. In verification he sent me a pair for inspection.

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* *Y. kizuki.* "*Hab.* Japan (island of Kiusiu), and, according to Dr. Stejneger, the southern part of Hondo"! But why "according to Dr. Stejneger," when he himself enumerates as *Y. kizuki* a specimen from Kobe? !

No. 1960, a young male from Norikura, July 18, 1891, is quite interesting. It is generally paler than the adults and the pattern less decided; the lateral nuchal red patches are present, but nearly the whole top of the head has whitish spots at the tip of each feather.

I may finally be allowed a few general remarks on the status of *Y. seebohmi*. It is a form but very slightly differentiated, but there is enough *average* difference between the specimens from Yezo and those from further south to make it profitable to retain the name for the northern form. But I will emphasize the fact that the differences between *Y. kizuki* and *Y. k. seebohmi*, which the authors above referred to have never ceased to maintain, are much smaller than the differences between the other races of woodpeckers in Japan and Kamtchatka described and named by me, but for which I have been held up to the horrified ornithological public as an unprincipled hair-splitter. Those who cannot appreciate the distinctness of *Dryobates purus* and *immutabilis*, of *Picoides albidior*, or *Picus yessoensis*, should give up *Yungipicus seebohmi* as soon as possible.

(167) **Dryobates japonicus** (Seeb.).

Dr. Ijima sends four specimens to help me solve the question as to the possible distinctness of the Yezo birds; one of the specimens (No. 1187, ♀, Sapporo, March 13, 1889, Nozawa coll.) being from the latter island, while three (No. 1413, ♀, Tokyo, November 30, 1890, Ijima coll., No. 1098, ♀, Sagami; and No. 1093, ♂, Ogawa, December 5, 1893) are from Hondo. I do not know the exact location of Ogawa, but I do not believe it to be south of Yokohama.

An inspection of this additional material only corroborates the view expressed in my paper on Henson's Hakodate birds (Proc. U. S. Nat. Mus., xv, No. 904, 1892, p. 299). The Yezo bird is the palest specimen, although very closely approached by the one from Ogawa, but in the former the white shoulder patch is decidedly larger. The Tokyo specimen has all the white portions strongly washed with deep ferruginous, evidently a superficial stain.

(255) **Pitta nympha** Temm. and Schl.

An adult specimen (No. 1580) from the province of Inaba.

I have compared it carefully with the pair collected by Mr. P. L. Jouy in Tsushima and find it to agree in every particular. The brown of the head only is a little deeper and a few of the middle wing coverts have near the tip a mesial black wedge, presumably due to age. The scutellation in the front of the tarsus is also unusually distinct, pointing in the same direction.

Dr. Ijima writes me in regard to this species as follows: "This is one of two specimens said to have come from the province of Inaba. I purchased both for the Museum. That this species does occur in the southern provinces, for instance in Kiu Siu, there can be no doubt at all. Mr.

Ota recently obtained a specimen from Owari. It is also mentioned in Japanese ornithological manuscripts, but seems never to come as far north as Tokyo. The Japanese name of this bird is *Yairocho*, meaning eight-colored bird, and its local name in Satsuma is *Akadanna* (aka= red; danna=cloth worn about the lower parts of the body)."

(224) **Accentor erythropygius** Swinh.

A male in nestling plumage collected by Kikuchi at Norikura, August, 1888 (No. 889). It is very much like the adult bird, wing and tail being identical, but the top of head is washed with ochraceous and streaked with blackish, and rump and under side, including flanks, more or less tawny-ochraceous streaked with dusky; the pattern on the throat is not so well defined.

(223) **Prunella rubida** (Temm. and Schl.).

No. 891, a nestling, collected by Kikuchi at Norikura-yama, Province of Shinano, August 19, 1888. Wing and tail as in adults; upper surface likewise, though with a tawny tinge instead of the vinaceous of the adults; under side pale tawny ochraceous fading to whitish on belly and indistinctly streaked with dusky.

A careful comparison of three specimens from Hondo with four from Yezo proves them to be absolutely identical. There does not seem to be the slightest foundation for the alleged subspecies *P. fervida.*

(261) **Turdus naumanni** Temm.

Two specimens with one of *T. eunomus* were sent by Dr. Ijima under the above name to illustrate a supposed combination of the characters of the two species. They are readily referred to their respective species, however, but the key by which the two species were supposed always to be distinguishable requires some emendation, as both specimens of *T. naumanni* show considerable dusky in the coloration of the flanks. The differences in the color of the outer tail feathers, under tail-coverts, under wing-coverts and rump seem to be always constant. Taking Robert Ridgway's "Nomenclature of Colors" as a standard, we find that the under wing-coverts and outer tail-feathers in *T. naumanni* are of a color somewhat intermediate between the cinnamon (Pl. III, Fig. 20) and tawny (Pl. V, Fig. 1), while the under wing-coverts in *T. eunomus* are intermediate between cinnamon rufous and vinaceous-cinnamon (Pl. IV, Figs. 16 and 15), or for all practical purposes the former, and the tail practically uniform brownish slate; the latter species, in addition, has a strong wash of rufous chestnut on the rump. Besides, in *T. eunomus* the central portion of the longest under tail-coverts always has some dusky added to the brown, while in *T. naumanni* it is unmixed, of the same color as the under wing-coverts.

The superficial resemblance between the three birds sent is undoubtedly due to their being somewhat youngish birds.

With a series of over thirty specimens before me I must agree with Mr. Seebohm that these well defined species do not intergrade, and there should be no difficulty in properly identifying even young birds by comparison, though the differences may be somewhat difficult to express in words, and difficult to grasp even when well expressed.

The two specimens of *T. naumanni* were collected by Dr. Ijima at Tokyo, February 17, 1889 (Sc. Coll. Mus. Nos. 756 and 757), and are both males.

(254) Pratincola maura (Pall.).

A young in transition from the nestling plumage collected by Dr. Ijima at Norikuri, July 24, 1891.

I have but little to add since I last wrote about these species (Pr. U. S. Nat. Mus., xv, 1892, pp. —), except that I have now been able to examine several breeding specimens collected by Dr. Abbott in the Vale of Cashmere during July, 1891. These belong to the smaller bright race and tally, consequently, exactly with Oates's description of the Siberian examples. When, therefore, he says (Fauna Br. India, Birds, II, 1891, p. 62): "Siberian specimens of Bush-Chats are not very numerous, but all I have seen are so intensely black on the head and back, so intensely rufous on the breast, and, moreover, so small, the wing not exceeding 2.6 in length, that I have not been able to match them with any breeding bird from the Himalayas, except in the case of one bird from the interior of Sikkim," it would almost seem as if two forms, were breeding in the Himalayas, probably in different parts.

Comparing these Cashmere birds with my specimens from Japan I find no other difference than the width of the bill at base, which is markedly greater in the Japanese birds.

(207) Cyanoptila bella (Hay).

A young male in nestling plumage (No. 2015), collected by Dr. Ijima at Norikura, July 21, 1891, demonstrates beyond the slightest doubt that the two sexes are perfectly distinguishable in the nest. This specimen which has the characteristic buff plumage, scaled with blackish margins to the feathers, has the blue edges to the wing-feathers and the blue tail broadly white at base, like the the adult males, thus strongly contrasting with the female nestling collected by Jouy (U. S. Nat. Mus., No. 88616) which combines the same scaly nest plumage with the brown wings and tail of the adult female.

Mr. Seebohm has also an innovation in regard to the genus of this bird, for he now refers it to *Niltava*. The change could hardly have been more unfortunate, and is perfectly in line with his lumping of the genera *Sialia* and *Grandala;* but then they are all blue! It seems, however, as if he was somewhat dubious, since the typical *Niltava* has no white on the tail, though taking comfort in the fact that "both have the curious pale patch on the throat" (B. Jap. Emp., p. 59). But then, *Ficedula albicilla*

has the identical pale patch! True, it is not blue, but what of "*Tarsiger*" *cyanurus*, which has *both* the blue color and the pale throat patch?! It is clear that the pale throat patch is of higher than "generic value."

On the other hand, were we to be guided by color alone, we should feel tempted to place *Cyanoptila* near some of the species now referred to *Cyornis*, but in view of the very weak feet and long wings of our present species, it will be well to keep them apart until a more natural arrangement of *all* the flycatchers can be effected. The experiment of exchanging one uncertainty for another is hardly scientific.

(210) Ficedula ferruginea (Gm.).

A young male from the province of Yamashiro (No. 1645).

Mr. Seebohm has recently referred this species to the genus *Siphia*, of which *S. strophiata* is the type, but as I shall show, with but poor reason. Oates has placed the species usually called *Erythrosterna* in the same genus, but having no access to the type species of *Siphia* I am unable to say whether he is right or wrong. As I can find no valid character by which to separate either of them generically from *Ficedula*, it matters little as far as my nomenclature is concerned. It it quite plain that it is a certain resemblance in the coloration that has led Mr. Seebohm to the ill-advised step of calling this bird *Siphia*, as will appear from the following quotation (B. Jap. Emp., p. 60): "The Mugimaki Flycatcher belongs to the genus *Siphia*, in which, although the sexes differ in color, *they agree in having the base of the tail more or less white and the upper tail-coverts nearly black.*" I have italicized the last paragraph for the reason that it is entirely erroneous. In the "Mugimaki Flycatcher" the sexes do *not* agree in these points at all, inasmuch as the female has the tail perfectly uniform, without any white at base and the upper tail-coverts not black, but uniform with the back. There is consequently no reason to join *Poliomyias* with *Siphia* on account of the coloration.

Locustella hondoensis, sp. nov.

Diagnosis.—Rictal bristles obsolete, outer tail-feathers two-thirds, the central ones entirely, covered by under tail-coverts; upper parts uniform olive; culmen, to extreme base, more than 16.5^{mm} (0.65 inch).

Habitat.—Japan.

Type.—Sc. Coll., Tokyo, No. 1669; province of Shimosa.

The type, although a young bird, clearly belongs to an undescribed species, for not only is the coloration unique, but the length of the bill is quite as characteristic. In proportion to its size (all feathers fully grown) the present form is, in fact, the longest billed species among related birds. The shape of the bill is exactly that of *L. fasciolata*, though somewhat slenderer on account of its proportionally greater length.

The color of the upper surface is uniform and rather dark olive, without any of the brownish cast so universal in the other species of *Locustella*, a peculiarity of coloration the more remarkable since it is clearly a young bird, and young birds of this genus are usually strongly suffused with yellowish, or buff, on the upper parts as well as on the lower.

That the bird in question really belongs to the genus *Locustella*, and has to be compared with species of that genus alone, will be plain from some of the characters mentioned in the diagnosis, viz, the rudimentary development of the rictal bristles and the great extent of the graduation of the tail. To make perfectly sure, I may add that the tail consists of twelve feathers, and that the first (tenth, or distal) primary is very small, just extending beyond the primary coverts, and less than one-third the second.

The bird in question probably belongs to the group of the genus which has no subapical blackish bar across the tail-feathers, the specimen before me showing no trace of it, but as this character is less developed in the young birds than in the adults I do not venture to be positive about it.

It remains to compare the specimen with those species of the genus which have uniformly colored upper parts.

L. fluviatilis and *luscinioides*, being exclusively western palæarctic, hardly need mention, but to make the comparison complete I may remark that, aside from their shorter bills, their wing formulæ are entirely different from that of our bird.

L. fasciolata is a much larger bird, with an entirely different color of the back. The wing formula is also sufficiently different.

In average size *L. ochotensis** comes nearer to our bird, but its bill is much shorter and the coloration is different. The young *L. ochotensis* (Phil. Acad., No. 30068, and U. S. Nat. Mus., No. 96247), now before me, are distinctly tawny above, and the yellow below is more inclining to buff. There are structural differences besides, for both remiges and rectrices are considerably broader in *L. ochotensis*, and the third primary, particularly, is much more curved near the tip.

The possibility of finding a name among the several synonyms of *L. ochotensis*, which in reality might turn out to belong to our bird, has been investigated, but without favorable result.

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*By this name I understand here the bird now usually so called, but I can not refrain from recording my suspicion that two distinguishable forms are confounded under that name. I find on comparison of Kamtchatkan and Japanese (including Kurile) specimens, that the latter have a much shorter second primary and a considerably more tawny color on the upper surface than the latter. I am inclined to think that the Kamtchatkan specimens are identical with those collected by Middendorff at Udskoj Ostrog, and that their migration route from and to Kamtchatka is identical with that of *Chelidon tytleri*, at least for the first part of the route. They would then be typical *L. ochotensis*. The Kurile and Japanese specimens are then entitled to the name *Locustella japonica* (Cass).

The first name we encounter is Cassin's *Lusciniopsis japonica* (Pr. Phil. Acad., 1858, p. 193). Through the courtesy of Mr. Witmer Stone the type (Phil. Acad., No. 30068), from Hakodate, is now before me. It is a young bird and in every detail a counterpart of U. S. Nat. Mus., No. 92648, also from Hakodate, and collected by Capt. Blakiston. Both are referable to the species from Japan which we are used to call *L. ochotensis*, and consequently, not to the present bird.

The next bird in order is Swinhoe's *Locustella subcerthiola* (Ibis, 1874, p. 154), based upon another specimen from Hakodate collected September 3, 1861, by Blakiston (Blak., No. 734), and by him referred to "*Calamoherpe cantillans*." The type is probably not now in existence, as it is neither in the Swinhoe collection, nor in the U. S. National Museum (see Seebohm, B. Jap. Emp., p. 73), but Blakiston's reference to the similarity of the bird to the plate in Fauna Japonica of *Salicaria cantillans* and to *Acrocephalus orientalis* makes it certain that it was a *L. ochotensis* and not the bird we are now considering.

Arundinax blakistoni was described two years later by Swinhoe from a young specimen collected by Blakiston at Hakodate. The type is in Seebohm's possession, who declares it to be an *L. ochotensis* in first plumage. Moreover, Capt. Blakiston retained in his own collection a duplicate specimen (fairly entitled to be regarded as a co-type) obtained on the same date and at the same place (Hakodate Light Ship, Oct. 3, 1875), which is now before me (U. S. Nat. Mus, No. 96248, Blak., No. 1880), and is the same young bird with which I have compared the new species above.

There is consequently no other alternative but to bestow a new name on the Shimosa bird, and to recommend collectors to keep a sharp lookout for the adult bird.

To facilitate identification I append the following detailed description of *Locustella hondoensis*.

Coloration.—Entire upper surface uniform olive (Ridgway, Nom. Col., pl. III, fig. 9), underside pale Naples yellow washed with olive on sides and becoming clay-colored on under tail-coverts; chest, spotted with dusky; a dull olive-buff superciliary stripe; ear-coverts olive, with pale shaft-streaks; lining of wing whitish. Bill, brown above and on tip of lower mandible; base of latter and terminus of upper pale.

Dimensions—	Millimetres.
Wing	63
Tail-feathers	57
Exposed culmen	15
Culmen to extreme base	18.5
Tarsus	24
Middle toe with claw	21
Middle of bill at middle of nostrils	4
Graduation of tail	18

Wing formula:—First primary 2^{mm} longer than primary coverts; second primary equals fifth; third longest, longer than fourth.

Acanthopneuste borealis (Blas.).

Acanthopneuste borealis xanthodryas (Swinh.).

An undated and unsexed specimen from the province of Suruga (No. 2156) is an undoubted *A. borealis.*

The other bird (No. 2038), collected by Dr. Ijima at Norikura, province of Shinano, Hondo, July 27, 1891, is very young, and it is consequently not possible at the present state of our knowledge to say, with absolute certainty, whether it is a *A. xanthodryas* without examining the parent bird. The coloration is typically that of *A. xanthodryas*, and as the first primary is fully 15^{mm} long I think Dr. Ijima quite correct in referring it to the latter.

(**244**) **Acanthopneuste tenellipes** (Swinh.).

Dr. Ijima has forwarded a specimen collected at Sapporo, Yezo, October 4, 1890. It belongs to the Sapporo Museum (No. 820) and is particularly interesting as the only autumnal specimen so far obtained in Japan.

(**180**) **Zosterops japonica** Temm. and Schl.

Dr. Ijima sends the two Tsushima specimens (Nos. 1749, 1750) which he discussed in his paper on the Tsushima birds (Journ. Coll. Sc. I. Univ. Jap., V, 1891, p. 109). As he remarks, the bills of these birds are somewhat larger than those from Hondo, but the difference is trifling in itself and I have before me a third specimen from Tsushima collected by Jouy (U. S. Nat. Mus., No. 114646) which in its measurements is absolutely identical with those of Peterson's No. 77, from Nagasaki, recorded by me in Proc. U. S. Nat. Mus., 1887, p. 487, both birds being females. I can discover no difference in coloration and wing-formula and must refer the Tsushima birds to true *Z. japonica.*

This opens up the question of the status of *Z. stejnegeri* Seeb. from the Seven Islands. I have reëxamined our specimen from Oshima, the northern island of the group, but beyond the fact that the bill is 1 millimeter longer than the longest Tsushima bill, I can see no difference. The measurements presented by Seebohm of birds from the southern islands of the group seem to average longer, and it may be that the birds from those islands may be larger generally. It is evident, however, that the Oshima bird as well as various larger specimens from Hondo, Kiu Siu, and Tsushima, are intermediate, and that the bird in question is only entitled to a trinominal appellation, as *Zosterops japonica stejnegeri.*

Seebohm, in his paper on the birds of Tsushima (Ibis, 1892, p. 90), says that "no species of this genus has been recorded from Corea," but he has evidently overlooked my reference in Proc. U. S. Nat. Mus., 1887, p. 486.

(**205½**) **Lanius magnirostris** Less.

A young specimen of this rare Japanese bird, collected at Nikko, Hondo, (No. 1657) is the fourth specimen obtained in Japanese territory.

The first one was an adult bird collected by Mr. Pryer at Fujisan; the second, an adult female, by P. L. Jouy on Fuji, July 2, 1882 (U. S. Nat. Mus., No. 91455); and the third, a fine adult male, by the same gentleman on Tsushima, May 22, 1885 (U. S. Nat. Mus., No. 114639).

(195) **Pica pica media** (Blyth).

A comparison of specimens of true *Pica pica* from Europe with examples from China, Korea, and Japan has convinced me of the subspecific distinctness of the eastern magpie. The essential difference consists in the color of the secondaries and greater coverts which in the adult *P. media* are considerably more purplish blue than in the typical form.

The specimen in the Science College Museum (No. 1581) is an adult collected in the Province of Hizen (in which Nagasaki is situated) Kiu Siu.

Sturnia sinensis (Gm.).

Two specimens (Nos. 2165 and 2166) were purchased in the flesh from a game dealer in Tokyo, February 10, 1889. According to Dr. Ijima they were skinned by Sakamoto, who found shot holes on the body. They show no signs of being escaped cage birds, and as there is but slight probability of their having strayed from their regular habitat in China, the inference is that a colony of these birds may have become established somewhere in Hondo, probably originating from escaped or willfully liberated cage birds.

Both specimens are nearly entirely void of the usual salmon-colored suffusion, and the younger specimen is shedding some of the remiges.

(272) **Emberiza personata** Temm.

I can corroborate Dr. Ijima's identification of No. 1748, Uchiyama, Tsushima (Jour Sc. Coll. I. Univ. Jap., v, 1891, p. 116). It is unusually pale, in fact so much so that at first I was inclined to regard it as *E. spodocephala*. An examination of the outer tail-feathers, however, at once shows it to be *E. personata*, as in this species the dusky of the outer web invades the inner web toward the tips to quite a considerable extent, while in *E. spodocephala* it is almost totally confined to the outer web.

Another specimen (No. 2187) from the Province of Owari is also sent. There is a pinkish color, especially on the under side, evidently an accidental stain.

Emberiza ciopsis ijimae, subsp. nov.

Dr. Ijima has kindly sent for my inspection three of the Tsushima birds which he has discussed in his valuable paper on the birds from Tsushima, viz, Nos. 1751, 1753, and 1754 (Journ. Coll. Sc. I. Univ. Jap., v, 1891, p. 114). Without coming to a decision whether to refer these birds to *E. ciopsis* or to *E. castaneiceps* chiefly for want of specimens of the latter, he correctly pointed out the differences from the former.

For comparison with *E. castaneiceps* I have four males collected at Fusan, Korea, by Mr. P. L. Jouy during January, April, and May. It is evident from this material that the Korean birds differ from *E. ciopsis*, of which I have ten males at hand, in several other points in addition to having the ear coverts brown instead of black. Thus, the top of the head is at all seasons less mixed with blackish, and the rump is considerably paler. In both respects the Tsushima birds agree closely with the birds from the other Japanese Islands. It is, therefore, entirely out of the question to refer them in any way to *E. castaneiceps*. On the other hand, as pointed out by Dr. Ijima, they differ from typical *E. ciopsis* in the amount of the brown on the ear coverts. True, some winter birds from Japan proper match the least marked Tsushima birds of a later date, but in the former the brown disappears as the season advances, while in the latter it appears to be permanent.

Under these circumstances it seems best to recognize the Tsushima form as a separate race, which may be characterized as follows:

Emberiza ciopsis ijimæ, subsp. nov. Closely allied to *Emberiza ciopsis*, but the ear-coverts brown in the male during the breeding season instead of black.

Habitat.—Tsushima, Japan.

Type.—Sc. Coll. Mus., Tokyo, No. 1751. ♂ ad. Niimura, Tsushima, March 10, 1891; Namiye coll.

LAND SHELLS OF THE GENUS BULIMULUS IN LOWER CALIFORNIA, WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

BY

WILLIAM HEALEY DALL,

Honorary Curator of the Department of Mollusks.

(With Plates LXXI and LXXII.)

The peninsula of Lower California is known as the home of several interesting species of the genus *Bulimulus*, including what is, perhaps, the largest species of the genus, *B. montezuma*. As much of the peninsula, in its arid highlands, recalls the analogous districts of Peru and Chile, so the land shells, especially the *Bulimuli*, bear in their external characters the imprint of a similar environment, which has gone so far that, in one or two cases, the similar species of California and Peru have been referred to the same species. An examination of a good series shows, though this opinion proves to be mistaken, that there was reasonable ground for it in the remarkably similar effects produced by the similar environment acting upon plastic forms of the same genetic history, in the two widely separated regions. The reception of an interesting series of specimens from the California Academy of Sciences, collected by an exploring expedition sent out by them, and the attempt to name them, and simultaneously to review the species already well represented in the national collection, gradually led to the study embodied in the present paper.

The first species of the group from this region was described by Sowerby in 1833; others were named by Gould in the Boston Journal of Natural History in 1852–53. An account of most of the older species may be found in the "Land and Fresh-Water Shells of North America," Part I, by Binney and Bland, pp. 191–208, 1869. Later references to them appear in the great work by Crosse and Fischer on the land and fresh-water mollusks of Mexico, and in papers by Dr. J. G. Cooper in the proceedings of the California Academy of Sciences, second series, III, pp. 99–103, 207–217 and — —, with Pls. XIII and XIV, and also in Zoe, Vol. III, p. 11, April, 1892. The figures on the plates above mentioned are, unfortunately, not as characteristic as might be wished. There is also a short paper by the writer on *B. proteus*, in the Nautilus, of July, 1893.

Genus **BULIMULUS** Leach.

Section SCUTALUS Albers.

Bulimulus (Scutalus) pallidior Sby. (*B. vegetus* Gould.)

Normally arboreal; elevation 100–500 feet, chiefly in the southern part of the peninsula; San Jose del Cabo, Belding, Eisen; Cape St. Lucas, Xantus; Punta Arena, Bryant; Carmen Island, Stearns; Santa Margarita Island, U. S. Fish Commission; Costa Rica, Zeledon. (Plate LXXII, Figs. 2, 3.)

There is the typical form, polished and without any visible spiral striation, which varies from acute and slender ($20+40^{mm}$ and 7 whorls) to stout and short, with a larger umbilicus ($28+45^{mm}$ and 6½ whorls). It also varies a good deal in size. The specimens from Costa Rica are rather thin and the lips rather widely expanded. They agree perfectly in other respects with the Lower Californian shells.

The spiral striation in many specimens becomes pronounced and in some reaches a point comparable to the surface of the *B. montezuma*. For this variety I have used the varietal name *striatulus*. It is particularly noticeable in collections from Carmen and Margarita islands and the Gulf coast of the peninsula.

Bulimulus (Scutalus) montezuma Dall. (*B. proteus* auct. non Broderip.)

Almost confined to the mountains of the peninsula at an elevation of 2,000 to 3,500 feet (Cooper). See the Nautilus, July, 1893, p. 26. (Plate LXXII, Fig. 1.)

The variations of this species seem confined to greater or less elevation of the spire and more or less acute apical angle of the same. The specimens I have seen are more uniform in their general appearance than those of either of the other species of this region. They are never smooth, though the granules differ in prominence.

Bulimulus (Scutalus) Baileyi Dall, n. s. (*B. Xantusi* var., Stearns non Binney.)

Cape St. Lucas, W. J. Fisher and G. Eisen; Ortiz, Mexico, Vernon Bailey; Guaymas, Mexico, E. Palmer. (Plate LXXI, Fig. 1.)

Shell when perfectly fresh with a delicate brownish epidermis, which is usually lost, beneath which the shell is brownish flesh color with irregular pale streaks in harmony with the incremental lines; the margin of the whorl in front of the suture is also often whitish; dead shells are waxen or pure white, often with a ferruginous discoloration; whorls five and a half, the nucleus with a central pit or dimple at the apex, the first two turns regularly ribbed with small, sharp, rather distant ribs, the wider interspaces of which are spirally striate; subsequent whorls with close, fine, sharp, somewhat irregular wrinkles, in harmony with the incremental lines, sparser on the last whorl and crossed by fine sharp close striæ of variable strength, sometimes hardly visible, but in other specimens distinct and granulating the wrinkles; all intermediate grades are observable in comparing many specimens; suture distinct;

form like that of *pallidior* on a smaller scale, varying from moderately wide to slender; whorls rounded or moderately flattened; umbilicus small but deeper proportionately than in *pallidior;* aperture rounded ovate, the lip rather widely reflected, thin, the outer and pillar lips approximating, united by a thin wash of callus.

Measurements of a slender and a stout specimen, respectively.

	Millimeters.	*Millimeters.*
Altitude of shell	28.0	28.5
Altitude of last whorl	23.0	22.5
Altitude of aperture	15.0	16.0
Maximum breadth of aperture	11.5	12.0
Maximum breadth of shell	17.0	15.0

This species is larger than *B. Xantusi* and the latter is without a reflected lip. *B. Baileyi* has the color of *excelsus* rather than *pallidior.* Its variations, within the limits of its smaller size, are similar to those of *pallidior;* the granulation of the surface in the rougher specimens is much finer, but of the same character as that of *B. montezuma.* The species was at first confounded with *B. Xantusi*, the type of which had been mislaid, but when the latter was found and a series compared, it was obvious that they belonged to different sections of the genus. It is named in honor of Mr. Vernon Bailey, of the U. S. Department of Agriculture, who collected it in western Mexico.

Section DRYMÆUS Albers.

Bulimulus (Drymæus) californicus Reeve.

"California," Hartweg, fide Reeve; Gulf coast of Lower California, Stearns.

Only one specimem of this little-known species is in the national collection, and it unfortunately has had the pillar broken, apparently in removing the animal. It recalls *B. Liebmanni*, but is nearest to *B. serperastrus* Say, but is more slender than any specimen of *serperastrus* observed in our very large series from many localities. The peristome is reflected, especially in front, and the surface is polished.

Section MESEMBRINUS Albers.

Bulimulus (Mesembrinus) Xantusi W. G. Binney, not Cooper. (*B. Gabbii*, Crosse and Fischer.

Cape St. Lucas, Xantus (type); Rancho Lagunas, Punta Arena, near sea level, Bryant; Sierra Laguna, near La Chuperosa, altitude 2,000 feet, Eisen. (Plate LXXII, Fig. 4.)

The specimen from which Mr. Binney described the species, and which was figured to illustrate it, is in the National Collection (Mus. Reg. 9017) and must be regarded as the type. It is finely but intensely granular from the spiral striation, and agrees in every respect with the form described and figured by Crosse and Fischer in their fine work on the Mollusks of Mexico under the name of *B. Gabbii.* The lip is not

reflected in any of the specimens. The specimens collected by Bryant and Eisen are of the smooth, or rather not granulated variety *levis*, which accounts for Dr. Cooper's inability to harmonize them with Binney's description and figure. The epidermis is thin and olivaceous, and Dr. Cooper reports the most perfect specimen as being streaked with brown, lighter and darker, as on *B. alternatus*.

The type of *B. Xantusi* measures 20 mm. long, 10½ mm. in greatest width, the aperture 10 by 7 mm. The smooth ones are variable in size, measuring from 18 by 10.5 to 17 by 8.5 mm. None of the specimens received from Dr. Cooper show any trace of color markings. *B. digitale*, described by Reeve (Conch. Ic., Pl. 47, Fig. 308, November 1848) without habitat, bears from the figure a very close resemblance to *B. Xantusi*.

Section LEPTOBYRSUS Crosse and Fischer.

The type of this section is *B. spirifer* Gabb, but from a study of the species I am satisfied that several of the other species are too closely related to be separated from *B. spirifer* sectionally, though at first sight they fail to show the characters clearly. The section contains two sets of species, which are separated by the presence or absence of the prominent lobe or flange on the pillar in the first half of the last whorl, but all the species present occasional individuals which show a ridge here, even if the majority of the conspecific specimens do not. The nuclear whorls are peculiar, and agree closely, especially in the sunken position of the extreme nucleus making a pit or dimple on the apex of the spire; the nuclear whorls have a peculiar and when unworn a very sharp and characteristic sculpture, and most of the species have an extremely similar facies, the most aberrant form being *B. artemesia*, which, however, differs only by its more numerous whorls, slender form, and the less-reflected peristome. I am confident that all these species are genetically connected, and that they should be embraced in one sectional group.

Subsection A; without prominent lamella.

Bulimulus (Leptobyrsus) artemesia W. G. Binney.

Cape St. Lucas, Xantus, 1 (type) specimen; Sierra Laguna, at 3,000 feet above the sea, 2 specimens, Eisen. (Plate LXXII, Fig. 5.)

The type is in good condition; it has eight and a half whorls, of which the first two are obtusely keeled above and the nuclear point small and sunken, forming an apical funicular pit which is quite conspicuous. The sculpture of the nucleus is like that of the other species already mentioned, of rather sparse fine, sharp riblets, with the wider interspaces more or less spirally engraved. The surface is wrinkled finely, with traces of granulation here and there on the wrinkles. The peristome is slightly reflected, and inside thickened in the manner characteristic of a shell which has passed the dry season adhering to the bark of a tree. The pillar far within the aperture shows a faint elevated ridge. Traces of epidermis on the shell are pale olivaceous

yellow, the shell itself of a waxen white. It appears to be a rare species, and the furthest removed from the others which constitute the section. Yet I cannot believe that it is less related to *inscendens* (for instance) than to *B. pupiformis*.

Bulimulus (Leptobyrsus) inscendens W. G. Binney.

Cape St. Lucas, Xantus (types); Lower California, 100 to 3,000 feet above the sea, San José del Cabo, San Leonicio, etc., Eisen (typical form): Sierra Laguna, altitude 3,000 feet (smooth variety), Eisen; San José del Cabo and Punta Arena, Lower Cal. (var. *Beldingi* Cooper) Belding and Bryant. (Plate LXXII, Fig. 6.)

The type specimens of this species show the very distinct granulation due to spiral striæ, and have a nucleus like that of *B. artemesia*, obtusely keeled above. The pillar has a more or less distinct fold which, however, never becomes laminar, and is often feeble. The spiral striation may be coarse, fine, or absent, as in the species previously described. A smooth form—that is, one in which there is no spiral striation or granulation of the axially directed wrinkles, yet which has the form of the type, also occurs. Both this and the type have large shells with flattish whorls and a rather acutely conical spire. The other varieties are as follows:

Var. *alta* Dall; whorls rounder, shell shorter, last whorl 25–38, aperture 20–38 of the whole length. This form leads to var. *Beldingi*. Whorls 7½, altitude 38; maximum diameter 14 mm. Var. *monticola* Dall; more slender, smooth, compact, last whorl 23–40, aperture 17–40 of the whole length. This recalls *B. Bryanti* Cooper, but is less slender, has not the divergent last whorl, nor the laminiferous pillar. Whorls 7½, altitude 40, maximum diameter 14 mm. Var. *Beldingi*, Cooper; smaller, stouter, without spiral striation; last whorl 22–32, aperture 15–32 of the whole length. It is difficult, without a connecting series, to believe that this is not a distinct species from the typical *inscendens*. If they should be so divided hereafter, the above varieties *alta* and *monticola* would range with *Beldingi* rather than with *inscendens* proper. Whorls in the typical *Beldingi* 6½, altitude 32, maximum diameter 14 mm. The reflection of the peristome is narrower and thicker than in most of this group.

Bulimulus (Leptobyrsus) excelsus Gould, (*B. elatus* Gld, olim.)

La Paz, Xantus, Belding, Fisher. (Plate LXXII, Fig. 7.)

This is the largest, finest, and most local of the forms of this group. When fresh is streaked with waxen-white and purplish-brown and is whitish in front of the suture. It has two nuclear whorls obtusely keeled and with a less conspicuous apical pit than the others. The spiral striæ on the nucleus are often extremely faint, but can usually be made out with a magnifier on the later whorls. I have not seen any specimens where the striation was strong enough to granulate the wrinkles. While differing somewhat in form, the size is rather uniform

compared with that of the other species, as might be expected from its smaller range in area and altitude. The pillar bears an observable fold, but no lamina.

Bulimulus (Leptobyrsus) Zeledoni Dall, sp. nov.

Costa Rica, Zeledon, Mus. Reg. 98231. (Plate LXXI, Fig. 2.)

Shell thin, colorless, with translucent, polished, pale yellow epidermis and seven whorls; apical pit small, the nuclear whorls rounded, the riblets upon them close set and cut by equidistant spiral grooving, so as to produce a close, even reticulation like that of close-woven cloth; apex rather pointed, whorls slightly rounded, suture distinct; surface sculptured with obscure incremental wrinkles and very faint sparse spiral striæ; last whorl more than half the length of the whole shell; base rounded, with a narrow umbilicus, over which the pillar lip is broadly reflected; aperture short, wide, peristome thin, reflected, except near the sutural commissure, the reflection becoming more marked in proportion as one passes from the suture forward, and widest of all at the pillar, which is straight, almost forming an angle with the lip at its base; body with a slight wash of callus; a slight fold at the back of the pillar, but no lamina. Longitude of shell 30, of last whorl 17, of aperture 11; maximum latitude of shell 13.5, of aperture 10 mm.

I have included this species, collected by Señor Don José Zeledon, because it does not seem to be described, and also because it seemed naturally associated with the species of Lower California, to which this article is devoted. It is easily recognized when perfect by its nuclear sculpture and simple coloration, polished epidermis, and rather wide squarish aperture.

Subsection B, with a prominent lamina projecting from the pillar in the first half of the last whorl.

This group at present comprises three species, and the internal features are essentially the same in each. About the time that the penultimate whorl is beginning to be formed the pillar becomes gyratory, so that, viewed from below, it describes a spiral curve around an imaginary cylindrical axis of greater or less diameter. After completing its round and beginning on the last whorl the outer edge of the gyre becomes thickened and expanded in a fin-like manner with thick rounded margin; the twist of the pillar becomes more nearly axial, and at the aperture of the shell shows merely as a fold or rounded ridge such as appears in the various species of subsection A.

Bulimulus (Leptobyrsus) spirifer Gabb.

"In the mountains, among rocks, from San Antonio below La Paz to near San Borja, and in the highest mountains, perhaps even farther north." Gabb. San José on the Gulf of California. Belding. (Plate LXXII, Fig. 8.)

Nearly all the specimens in the national collection were received from Gabb, so that they are authentic. The species has been confounded

with others by several writers, but is clearly a distinct and well characterized form, and is the type of *Leptobyrsus*, according to the authors of that name. The species is noticeable for the oily gloss of its surface. The lamina is usually visible with difficulty or not at all from the aperture; "the prominent tooth winding inward from the columella," mentioned by Dr. Cooper,* is the fold on the pillar and not the lamina, which last he does not seem to have observed or differentiated.

The nucleus hardly differs from that of *inscendens*, the shoulder of it is rounded, not angular, and the spiral striæ are faint. The color of the shell is more brownish and less livid than in *excelsus*, the pale streaks, though frequently present, are less conspicuous, and the whitish edge of the whorl in front of the suture is less constant. The shell is the thinnest of all the species. It varies in form much like the others.

Bulimulus (Leptobyrsus) Bryanti (Cooper) Dall. *B. inscendens Bryanti* Cp. op. cit., p. 101, Pl. XIII, figs. 4 a–c, 1893.

"On dry mountains, 800 to 1,000 feet high, climbing high copal trees, northward from Cape St. Lucas, through a distance of 350 miles." Xantus, San José del Cabo, Bryant. (Plate LXXI, Figs. 3, 4.)

Usually white, but when living or fresh, pale-brown, showing hardly any spiral sculpture. Nucleus as in the last species. Lamina extraordinarily thick and rounded, not visible from the aperture. Surface nearly smooth but not polished; reflection of the peristome narrow and feeble.

This was referred to *inscendens* as a variety, but appears to be nearest to *spirifer* and a well-defined species.

Bulimulus (Leptobyrsus) Veseyianus Dall, sp. nov.

Espiritu Santo Id., Gulf of California. Belding. (Plate LXXI, Figs. 4, 5.)

Shell stout, inflated, brownish, polished, with seven whorls; suture appressed, distinct, but shallow; nucleus worn in all the specimens but apparently not differing from that of *B. Bryanti* except as being more blunt; whorls except the last rather rounded, the last whorl somewhat flattened at the periphery; umbilicus large but narrow, overshadowed by a very wide expansion of the pillar-lip; aperture large, the lips approximated behind, the reflection wide and greatly recurved, of a livid waxen passing into white at the margin; body moderately callous, pillar straight with an obscure fold visible at the aperture, internally with a large thick sublinguiform lamina; surface of the shell like that of *B. excelsus*, but more polished. Lon. of shell, 36.5; of last whorl, 25; of aperture, including the lip, 20; maximum diameter of shell, 20; of aperture, 15 mm.

This species is named in honor of Mr. J. Xantus de Vesey, to whom we owe much of our knowledge of the fauna of Lower California. It is recognizable by its short, stout shape, widely reflected recurved peristome, very narrow space between the commissures of the lips and body, and large subtriangular lamina. Five specimens, all very uniform, were collected by Mr. Belding (Mus. Reg., 34122) some ten years ago.

*Proc. Cal. Acad. Sci., 2nd series, Vol. iii, p. 211, 1892.

Section **ORTHOTOMIUM**. Crosse and Fischer.

Bulimulus (Orthotomium) sufflatus Gould. (*B. vesicalis* Gld. olim.)

Lower California, Rich; low lands about La Paz, Gabb; San José del Cabo to La Paz, Bryant. Sierra Laguna to 3,000 feet above the sea, Eisen. Variety *insularis* Cooper, Espiritu Santo Island, Bryant. Abundant near La Paz, Belding. (Plate LXXII, Fig. 9.)

This characteristic shell has no coloration except in its epidermis, which is straw color or pale olive, intensified at lines which represent resting stages, and more or less polished. The form varies from 33.5 by 17, and 36.5 by 21 to 32 by 23 mm. The peristome is slightly reflected in front and widely over the umbilicus; elsewhere it is not reflected. In specimens which have survived a dry season attached to bark or a stone, the inside of the peristome and the space on the body between the two lips is often much thickened by a deposit of callus. The nucleus is similar to that of *Leptobyrsus*, except that the apical part is irregularly punctate, and the riblets instead of being even and sharply defined are more or less wavy and on the shoulder and earlier part give a vermicular effect. The apical pit is not conspicuous though evident in some examples. Pathologic specimens showing lumps or tubercles on the pillar are not very rare, but normally the pillar is simple. The young are frequently taken for *B. pilula* from which they may be discriminated by their projecting and more sharply sculptured nuclear whorls and less open umbilicus as well as more ovate form.

Bulimulus (Orthotomium ?) pilula W. G. Binney.

Cape St. Lucas to Margarita Island, Xantus. San José del Cabo, Bryant. The specimens collected at Punta Arena by Bryant and mentioned by Dr. Cooper are probably immature *sufflatus*. (Plate LXXII, Fig. 10.)

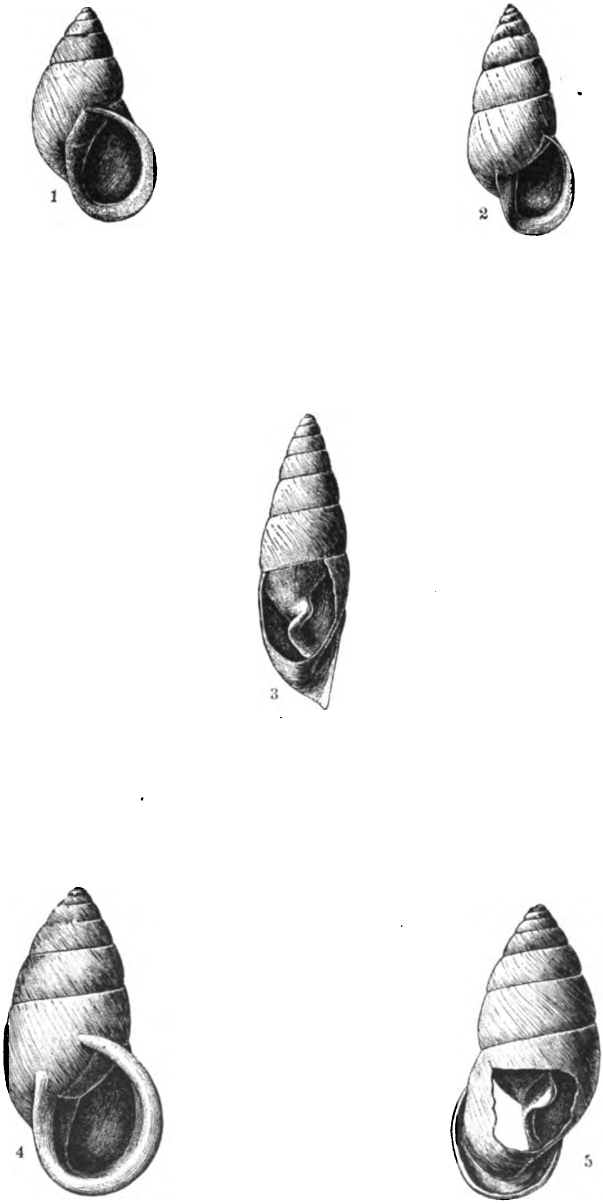
The types of this species in the National Museum have a distinct and mature appearance. The specimens connecting them with *sufflatus* are usually young *sufflatus*. The two types have 4 and 4½ whorls, respectively, as many as specimens of *sufflatus* four times their size. The nuclear whorls are smaller than in *sufflatus* and more delicately sculptured, while the incremental wrinkling on the body whorl is more conspicuous and regular than in the larger species. I have seen no specimens of *pilula* which appear to be genuine except the types. All the others when critically studied resolve themselves into varieties of *sufflatus*.

U. S. NATIONAL MUSEUM, *June, 1893.*

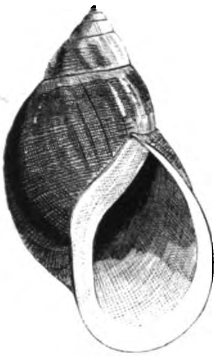
EXPLANATION OF PLATE LXXI.

		Page
FIG. 1.	*Bulimulus Baileyi* Dall	640
2.	*Bulimulus Zeledoni* Dall	644
3.	*Bulimulus Bryanti* (Cooper) Dall, from behind, showing internal lamella through an opening made into the whorl	645
4.	*Bulimulus Veseyianus* Dall	645
5.	*Bulimulus Veseyianus* Dall, from behind, the whorl opened to show the otherwise invisible lamella	645

EXPLANATION OF PLATE LXXII.



LOWER CALIFORNIAN BULIMULUS.



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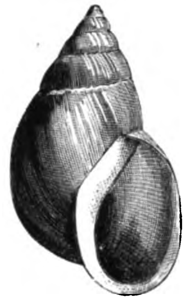

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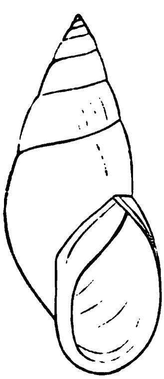

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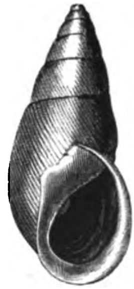

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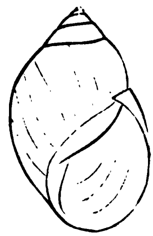

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10

LOWER CALIFORNIAN BULIMULUS.

DESCRIPTIONS OF NEW SPECIES OF AMERICAN FRESH-WATER CRABS.

BY

MARY J. RATHBUN.

(With Plates LXXIII–LXXVII.)

Family PSEUDOTHELPHUSIDÆ.

PSEUDOTHELPHUSA Saussure.

The synonymy of this American genus with a complete list of species is given by Prof. S. I. Smith in the Transactions of the Connecticut Academy, Vol. II, 1870. In the Annals and Magazine of Natural History (6) III, p. 7, 1889, Mr. R. I. Pocock describes a new species (*P. tenuipes*) from Dominica, and gives distinguishing characteristics of all the species. The collection of the United States National Museum contains no described species of *Pseudothelphusa*, but the genus is represented by eight new species. They all possess a cervical suture, two epigastric lobes separated by a median suture, two small Y-shaped depressions near the posterior margin of the gastric region, and five rows of spines on the dactyls of the ambulatory legs, three rows above and two below. The exognath of the external maxillipeds is shorter than the ischium of the endognath. The species are grouped according to the character of the front.

A'. Front not vertically deflexed, but rounding smoothly downward to the inferior margin.

Pseudothelphusa jouyi.

(Pl. LXXIII; Pl. LXXIV, Figs. 1–3.)

Carapace convex, punctate, smooth, and shining, much broader in the male than in the female. Cervical suture short and curved, sometimes not continued to the antero-lateral margin. Epigastric lobes faintly indicated by a short horizontal groove in front of them, of a lighter color; sometimes the groove is obsolete, but the color remains. There is no trace of a superior frontal crest, the front rounding smoothly down to the margin, which is not visible from above and is strongly retreating at the center. Median sulcus shallow, dividing the front

into two lobes. Seen from in front, the margin is nearly horizontal; seen from below, the two lobes are slightly arched forward. There is no outer orbital fissure. The frontal and upper orbital margins are indistinctly ridged, and are granulate in small specimens; in large ones the ridge is uneven, the normal granulation being feebly indicated. Lower orbital margin granulate. Antero-lateral margins finely denticulate, the denticles obsolete in adult males, where the margin is simply uneven. Ischium of maxillipeds elongate, merus subtriangular, endognath but slightly overlapping the jugal area; exognath shorter than the ischium (Pl. LXXIV, Fig. 3). The inferior surface of the body is punctate, the punctæ being larger next the orbit. The cervical suture is present on the lower surface. The abdomen of the male (Fig. 1) is widest at the distal end of the third and the proximal end of the fourth segment; lateral margins of third and fourth segments convex, of fifth concave. Extremity of appendage of first segment with lateral expansions above, the outer one larger and with a single sharp tooth pointing outward and downward, the inner one with a spatulate tooth pointing forward and inward (Fig. 2). The abdomen of the female conceals the sternum. Chelipeds very unequal. Merus with short, stout spines on the inner margin; upper margin with dentiform tubercles on the proximal two-thirds; lower outer margin rounded, with a few granules; a line of granules on the inner surface near the carpus. Carpus punctate, with a short, broad longitudinal groove above and a stout inner spine. Larger hand in male much inflated, punctate, smooth; fingers widely gaping, with strong teeth. Smaller hand with margins subparallel, fingers almost meeting when closed. In the females the chelipeds are more nearly equal, and in character resemble the smaller cheliped of the male. Ambulatory legs little compressed; merus slender, with upper and lower margins subparallel, upper margin blunt, with depressed spinules, which become obsolete in adults; carpus feebly spinulous above; propodus, above and below.

Color, a rich reddish brown.

Length of ♂ 27mm; width, 43.5; length of large cheliped, 86. Length of ♀ 29; width, 46; length of large cheliped, 66.

Many specimens were collected by Mr. P. L. Jouy in 1892 at the following localities in Mexico:

Lake Chapala, about 5,000 feet elevation, among stones and shingle on lake shore; February 19, 7 ♂, 80 ♀, mostly with eggs (17718); February 20, 7 ♂, 2 ♀, 4 young, all small (17719).

Juanacatlan, Falls of Rio San Juan, between Lake Chapala and Guadalajara, April 26; 6 ♂, 11 ♀, mostly small (17720).

Prof. A. Dugès has presented specimens from Valle de Santiago, State of Guanajuato; 1 ♂, 1 ♀ (17721); also an additional female (4122) from the same State, probably from the same locality.

This species bears a strong resemblance to *P. americana* Saussure from Hayti, but that species is without a cervical suture.

Pseudothelphusa dugesi.

(Pl. LXXIV, Figs. 4 and 5.)

This species is so closely related to *jouyi* that one might easily confound the two. It can be distinguished, however, first, by the front which is sinuous and slightly bilobed, more abruptly deflexed than in *jouyi*, with a strong marginal ridge visible from above and defined by a submarginal groove; viewed from in front the margin is nearly straight; second, by the more compressed meral joints of the ambulatory legs, which are slightly dilated in the middle, the upper edge thin; third, by the appendages of the first segment of the male abdomen, in which the inner tooth at the extremity is more slender than in *jouyi* and is directed closer to the appendage.

Color, dark olive-brown.

Length of male 21; width, 33; length of cheliped about 53^{mm}. Length of female, 20; width, 33.5; length of large cheliped, about 43.

Cuernavaca, State of Morelos, Mexico, P. L. Jouy, August, 1892; 7 ♂, 1 ♀ (17722).

A small female from the State of Guanajuato (?), A. Dugès (4389), has the meral joints of the ambulatory legs proportionally wider than in the specimens from Cuernavaca, all of which are much larger.

Pseudothelphusa terrestris.

(Pl. LXXIV, Figs. 6 and 7.)

This species much resembles *jouyi* and *dugesi*, but the carapace is wider, the cervical suture deeper and more conspicuous, the gastric region more elevated. Front not rounding downward as in *jouyi* but abruptly deflexed as in *dugesi*, the margin strongly ridged, defined by a well-marked submarginal groove, and visible from above. Viewed from in front the two halves of the margin slope downward toward the center. The outer orbital angle is less advanced than in *jouyi*. The denticles of the antero-lateral margins are less prominent than in specimens of *jouyi* of equal size, the obliteration in adults being even more complete in this species. In the abdomen of the male the terminal segment is more acute than in *jouyi*; the appendage of the first segment differs in having at the tip on the outer side a much narrower lateral expansion with a narrower, sharper tooth, and on the inner side, a somewhat scythe-shaped tooth. Chelipeds similar to those of *jouyi;* the lower outer margin of the merus has a distinct line of granules. The ambulatory legs are more compressed, the merus joints thin above and wide in the center.

Color, olive-brown.

Length of ♂ 21; width, 36; length of large cheliped, about 59^{mm}. Length of ♀ 19; width, 32; length of large cheliped, about 33. In this female specimen the chelipeds are almost equal.

Collected by Mr. P. L. Jouy at Atamajac, 3 miles west of Guadalajara, April, 15, 1892, 3 ♂, 2 ♀ (17723); also at Barranca Ibarra, near Guada-

lajara, April 20–22, 1892, under stones on moist hillside, about 10 feet above the river, 3,700 feet above sea level, and 1,500 feet below Guadalajara, 8 ♂, 8 ♀, small (17724).

A″. Front vertically deflexed, forming a blunt crest.
B′. Crest smooth.

Pseudothelphusa verticalis.

(Pl. LXXIV, Figs. 8 and 9.)

Carapace flattened, obscurely punctate. Cervical suture deep and short, continued to the margin. Epigastric lobes depressed. Front vertically deflexed; superior margin not ridged or granulate, but presenting a smooth, rounded surface, which is almost straight and scarcely interrupted by the shallow median sulcus. Infero-frontal margin with a prominent ridge, indistinctly granulate, a submarginal groove, and a shallow median sinus. The ridge is continuous with the orbital margin. Antero-lateral margins denticulate. Orbits deeper than in *jouyi*, sometimes with a shallow hiatus. In the male abdomen the appendages of the first segment are very different from those of the species above described (Fig. 9). Chelipeds with the merus triangulate, broadening distally, shorter than in *jouyi;* upper margin with dentiform tubercles, which become almost obsolete toward the carpus; lower inner margin with two irregular rows of spiny teeth; lower surface with a line of granules on the outer and distal margins; carpus shorter than in *jouyi;* large hand very deep and swollen, much larger than the small hand; fingers gaping in the larger cheliped. The ambulatory legs are compressed, broad; merus joints much dilated, with a thin upper margin, obscurely denticulate.

Length of ♂ 25; width, 42; length of large cheliped 72^{mm}.

Length of ♀ 22.8; width, 39; length of large cheliped 54^{mm}.

Tehuantepec, Mexico, Dr. Spear; 4 ♂, 5 ♀ (2537).

B″. Crest tuberculate.

Pseudothelphusa xantusi.

Carapace in shape resembling the preceding, slightly convex, punctate, granulate anteriorly and laterally. There is a trace of an additional suture behind the cervical suture, which is not an even curve, but turns slightly toward the horizontal near the margin. Epigastric lobes well-marked, tuberculate, separated by a deep, narrow median sulcus, which divides the superior frontal crest. This crest is blunt, and is provided with a wide row of tubercles, and near the orbit turns backward, following the line of the orbit for a short distance. Inferior frontal margin with a prominent ridge, which projects forward, is somewhat bilobed, granulate, and visible from above. Orbits large, not filled by the eyes; margin granulate except for a short distance beneath the outer angle, where the absence of granules simulates a shallow fissure. Antero-lateral margin denticulate, slightly interrupted

at the cervical suture and between that suture and the orbital angle. Merus of maxilliped more quadrate, less triangular than in the preceding species. Inferior regions of the carapace very finely granulate and punctate, cervical suture present. Jugal area pubescent as far back as the sternum. Small cheliped (the only one present) granulate, punctate, with a broad merus; inner face outlined below and distally with bead-like tubercles, inner margin with a double row of blunt spines, increasing in size distally, upper margin with spinulous rugæ extending on the outer surface distally. Carpus with a very shallow sulcus, a short inner spine; inner margin spinulous. Upper and lower margins of hand subparallel; fingers in contact. The merus joints of the ambulatory legs are flattened, widening toward the center, denticulate above; carpal and propodal joints spinulous on the upper, inner, and distal margins.

Length, about 29; width, 49; length of smaller cheliped, about 61^{mm}.

? Mexico, John Xantus; a single mutilated specimen, ♀ (2527).

This specimen is labeled "Cape St. Lucas", but it is more likely to have come from the vicinity of Manzanillo or Colima, where Mr. Xantus made valuable collections of fresh-water fishes and mollusks in 1862.

A'''. Front vertically deflexed, forming an acute lamellate crest.

Pseudothelphusa colombianus.

(Pl. LXXIV, Fig. 10; Pl. LXXV, Fig. 1.)

Carapace slightly convex, finely punctate, granulate anteriorly and near the lateral margins, the granules more evident in the smaller specimen. Epigastric lobes very prominent, the ridge continued faintly for a short distance in a transverse line of granules. Cervical suture curved, becoming less marked near the lateral margin. Superior frontal margin lamellate, almost straight, tuberculate, divided by a V-shaped notch at the extremity of the median sulcus. The margin near the orbit turns nearly parallel to the orbital margin and terminates just above the base of the eye. Inferior frontal margin slightly in advance of the superior, sinuous, with a prominent, horizontal, ridged, and granulate margin, which is continuous with the tuberculate or crenulate orbital margin. Front deepest at the outer ends. Antero-lateral margins denticulate, interrupted by a shallow sinus at the cervical suture and another between that and the orbit. External orbital fissure small and shallow, formed by the absence of one or two granules. Inferior surface of the carapace finely granulate near the margin. Jugal region pubescent and anteriorly granulate. Chelipeds of female unequal, punctate. Smaller cheliped much like that of *xantusi*, but with few granules; the inner margin has a single row of spines, and below it a row of tubercles. Larger cheliped similar to the smaller, except that the propodus is much deeper (Pl. LXXV, Fig. 1). Fingers in contact when closed. Ambulatory legs little compressed; meral joints widening toward proximal end, denticulate on upper margin, and in the last pair prominently ridged

on lower outer margin; carpal joints spinulous above and distally; propodal joints with small spines above, below, and distally.

Length, 28.5; width, 50; length of cheliped, about 65^{mm}.

River David, Chiriqui, United States of Colombia, about latitude 8° 28′ N, longitude 82° 24′ W., at an elevation of 4,000 feet above the sea; "very rapid streams descending from Mount Chiriqui"; J. A. McNiel, July, 1883; 2 ♀ (5512). In the same bottle there is an ambulatory leg of a specimen one-half again as large, which is apparently the same species.

Pseudothelphusa lamellifrons.

(Pl. LXXV, Figs. 2–5.)

The carapace of this species is allied to that of *colombianus;* the granules of the anterior and lateral portions are, however, more prominent, and the cervical suture is supplemented by another shorter parallel suture a little posterior to the first, but not prolonged to the margin. Front similar to that of *colombianus*, but narrower and deeper. External orbital fissure very shallow and broad, with a denticle in the middle. Antero-lateral margin very thin and acute, with fine teeth a little more prominent than in *colombianus* and crowded close together. Ischium of maxilliped broadening noticeably at the distal end. Abdomen of male contracted at the fifth segment (Fig. 4); the extremity of the appendage of the first segment is laminate, and folded and compressed laterally, the inner side having two lobes above, the posterior one very large, and the outer side with a blunt tooth pointing forward and outward (Fig. 5). Chelipeds in shape and armature resembling those of *colombianus*, but the granules are prominent; the upper and lower margins of the basal portion of the larger propodus more acurate than in those of the female of that species. Fingers in contact. The meral joints of the ambulatory legs are compressed, very wide at the center, the upper edge thin.

Length, 22; width, 34.3; length of cheliped about 46^{mm}.

Isthmus of Tehuantepec, Mexico, F. E. Sumichrast; 3 males (3289).

Pseudothelphusa richmondi.

(Pl. LXXV, Figs. 6–10.)

Carapace more convex than in the two preceding species, finely punctate, with scaly granules near the lateral margin. Cervical suture deep and almost straight. Epigastric lobes well marked. Median sulcus short, making a V-shaped notch in the superior frontal margin. There are three faint depressed tubercles arranged transversely across the gastric region. Margins of front and orbits crenulate or granulate. Superior frontal margin nearly straight, as seen from above, but seen from in front, the two sides slope downward to the median line; the outer extremities join the orbital margin. Inferior

margin sinuous, its lobes visible from above (Fig. 6). The external orbital tooth and the next lateral tooth are finely dentate; posterior to the cervical suture there are ten small spiniform teeth nearly equal in size, followed by a diminishing series of spinules on the postero-lateral margin; the first of the ten teeth has, on one side of the carapace, one, on the other side two, accessory spinules. Orbital fissure broad, shallow, U-shaped. Inferior surface of the carapace granulate near the lateral margin, and granulate and pubescent on the jugal area. Maxillipeds broad, considerably overlapping the jugal area; ischium much wider at the distal than at the proximal end; merus more quadrate than in preceding species. Last two segments of the male abdomen longer and narrower than in *lamellifrons* (Fig. 7); appendages of first segment with superior portion of the extremity armed with three unequal spines, the inferior portion having a concave oval area. Chelipeds unequal, punctate, with scaly granules, which form rugosities on the outer surface of the merus; merus and carpus armed similarly to those of *colombianus*, except that there is not a continuous line of granules near the upper margin of the inner surface. Hands rough, with scaly granules, especially on the margins. Large hand deep, lower margin very convex. Fingers in contact. Meral joints of ambulatory legs compressed and widening toward the center; upper margins of meral, carpal, and propodal joints, and lower margin of propodal joints spinulous; dactyls very slender.

Length, 32.5; width without spines, 49; length of cheliped about 70^{mm}.

Found on dry land near a small creek which flows into the Escondido River, 50 miles from Bluefields, Nicaragua, by Mr. Charles W. Richmond, October 30, 1892; one male (17725).

POTAMOCARCINUS.

Established by Milne Edwards* for a species (*P. armatus*) which differs from *Pseudothelphusa* in having the superior frontal crest sharp and lamellate, and more prominent than the inferior, the carapace armed with strong spines and an external orbital hiatus.

This genus is doubtfully distinct from *Pseudothelphusa*, some species of which have an orbital hiatus; in *P. richmondi* the front is sharp and lamellate, though not entirely concealing the inferior crest. In *Pseudothelphusa* can be seen every gradation between the sharp-crested front and the smooth front without a ridge. There seems to be no external character to distinguish *Potamocarcinus* except the strong marginal teeth, which is hardly a generic character. The following species is therefore placed provisionally in this genus.

*Ann. Sci. Nat. (3), xx, p. 208, 1853.

Potamocarcinus nicaraguensis.

(Pl. LXXVI; Pl. LXXVII, Figs. 1-3.)

Potamocarcinus armatus Stimpson (not Milne Edwards), Proc. Acad. Nat. Sci. Phila., X, p. 100, 1858.

Stimpson, in his unpublished report on the Crustacea collected by the North Pacific Exploring Expedition, says of *P. armatus*, "We have but one specimen of this species, a small male, half an inch in length. It differs somewhat from the large female described by Milne Edwards, in that the carapace is punctated, and, toward the lateral margins, somewhat granulated. The second and third antero-lateral teeth are bifid. Dactyli scarcely quadrangular, almost rounded, also smaller and less spinulose. It was found at Omotepec Island in Lake Nicaragua, by Mr. Charles Wright, botanist of the expedition."

Potamocarcinus nicaraguensis is a large species; small specimens agree with Stimpson's diagnosis, except that the dactyls are not less spinulous than in Milne Edwards's figure of *armatus*.

Carapace broader anteriorly than in *armatus*, slightly convex, distinctly marked with small punctæ, granulate near the lateral margins, the granules most prominent in young specimens. Cervical sulcus deep and curved; there are wide and deep grooves either side of the posterior gastric area, and small Y-shaped grooves between them. The epigastric lobes are well marked, divided by a narrow sulcus leading to the front. Superior frontal margin horizontal, granulate, more advanced in the central portion; median fissure V-shaped. Front concave, the inferior margin much behind the superior, the two halves separately arched upward. Postorbital tooth obtuse, outer margin rounded. Second tooth broader, obtuse, often with one or more accessory teeth on its margins. Third tooth, that directly posterior to the cervical suture, broad, very variable in shape, but always bilobed. Remaining large teeth, four to six in number, irregular in shape and position, acute, spinous. There are often small intervening teeth. Postero-lateral margin with several spinules which decrease in size from the lateral angle. External orbital hiatus deep and wide; orbital margin granulate. Lower surface of the carapace granulate near the lateral margin and on the jugal area. The margin of the epistome is three-spined; median spine long and curved upward. As in *armata*, the endognath of the external maxillipeds is very wide and covers a portion of the jugal region; the exognath is much shorter than in *armata*, never exceeding one-half the length of the ischium. The appendages of the first segment of the male abdomen are very stout, and at the summit present a concave outer surface which has a spine at the antero-inferior angle, a lobe at the antero-superior and postero-inferior angles, and two spines at the postero-superior angle (Pl. LXXVI,

Fig. 3). Abdomen of female very large, concealing the sternum. Chelipeds long and strong, unequal, punctate; merus roughened above, inner margin spinous, the spines longer and stronger at the distal end; inferior margin granulate. Carpus with a very shallow median groove near the center, and a stout spine on the inner margin. Large hand much swollen, deep; there is a short line of tubercles on the inner side of the lower margin near the carpus; dactyl strongly arched; fingers and lower surface of hand speckled with small dark spots, which, on the fingers, are granulous; teeth of prehensile edges irregular, broad, and strong. Smaller hand less broad and deep; fingers in contact or slightly gaping; otherwise as in the larger hand. The chelipeds of the female are shorter and more slender than those of the male. The merus joints of the ambulatory legs are slightly compressed; upper and lower margins almost parallel; upper margin obscurely granulate; carpal joints unarmed; propodal joints spinulous on the distal portion; dactyli compressed, with five rows of spines.

Length of ♂ 57^{mm}; width without spines, 85; approximate length of larger cheliped, 158; length of propodus, 90; depth, 37; thickness, 23. Length of ♀, 63; width, without spines, 95; approximate length of larger cheliped, 135; length of propodus, 71; depth, 25; thickness, 15.

Lake Nicaragua, Dr. J. F. Bransford; 4 ♂, 2 ♀ (5837), grading in size from two inches to three-fourths of an inch in length.

Near Greytown, Nicaragua, Dr. Louis F. H. Birt; 2 ♂, 3 ♀ (13788) all large. Greytown is at the mouth of the river San Juan, an outlet of Lake Nicaragua.

Rio Frio, Costa Rica, a tributary of the San Juan, Charles W. Richmond, March 3, 1892; one ♀ (17957).

EPILOBOCERA Stimpson.

In 1860 Stimpson instituted the genus *Epilobocera* (Ann. Lyc. Nat. Hist. N. Y., VII, p. 234) for a fresh-water crab of the family Thelphusidæ, distinguished by the frontal process meeting the internal suborbital lobe, behind which the antenna passes to the orbital cavity. The merus of the external maxilliped is transverse, its anterior margin rounded, and the palpus goniarthroid. The type species, *E. cubensis*, was found in fresh-water streams near Santiago, Cuba.

In 1870 Prof. S. I. Smith (Trans. Conn. Acad. II, p. 150) gives a more detailed description of *E. cubensis*, and describes another species, *E. armata*, probably from the Bahamas. The generic diagnosis should be amended so as to include species in which the frontal process nearly joins the suborbital lobe, the character being at best of doubtful value. The following distinguishing characters may be added: A process projects from the upper side of the expiratory canal, and the exognath of the external maxillipeds overreaches the ischium of the endognath,

SYNOPSIS OF SPECIES.

A′ Superior frontal crest projecting beyond the inferior.
  B′ Carapace granulated near the margins above and below .... CUBENSIS.
  B″ Carapace not granulated near the margins .... ARMATA.
A″ Superior frontal crest not projecting beyond the inferior.
  B′ Carapace with coarse scaly granules near the margins above and below .... GRANULATA.
  B″ Carapace without coarse scaly granules near the margins .... HAYTENSIS.

Epilobocera haytensis.

(Pl. LXXVII, Figs. 4 and 5.)

Carapace very slightly convex, finely granulate, and punctate. Cervical sulcus deep. Cardiac region with shallow depressions on either side, and two minute Y-shaped grooves in the sulcus between the gastric and cardiac regions. Epigastric lobes distinct, separated by a well-marked sulcus, which extends forward and forms a wide median sinus in the superior frontal margin. This margin is prominent and nearly straight when seen from above, but slopes downward toward the middle, and in the larger specimen the two halves are inclined slightly backward toward the median line. The margin is unevenly tuberculate, and near the orbital border it is directed backward and ends above the base of the eye. The inferior margin of the front is three-lobed, the median lobe directed downward and forward, the lateral lobes rounded and horizontal, projecting well beyond the superior margin. The margin is crenulate, and also the orbital border, which is continuous with it. There is a broad hiatus beneath the outer angle of the orbit. The internal suborbital lobe is very broad and concave, and nearly, but not quite, touches the subfrontal process. The antero-lateral margin is marked by small blunt teeth, irregular in size and shape, and interrupted by a wide sinus at the cervical suture, and another near the external orbital angle. The teeth become smaller and more indistinct near the postero-lateral margin, which is slightly concave, smooth, and rounded. The marginal teeth are less plainly marked in the smaller specimen. Labial border of the epistome with three lobes; median lobe acute, projecting downward and slightly forward; lateral lobes shorter, less acute, their inner margins arched upward and forward. The margins of the lobes are tuberculate. On the lower side of the carapace there is a line of tubercles following the cervical suture, and the anterior portion of the jugal area is tuberculate. The endognaths of the external maxillipeds in width do not exceed the buccal cavity; the merus is more or less quadrate, the antero-external angle rounded (Fig. 5). The male abdomen is widest at the third segment, and does not taper regularly to the last, but the margins of the fourth, fifth, and sixth segments are separately convex. The appendages of the first segment are bent outwards at almost a right angle near the extremities, which are lobed and spinuliferous. Chelipeds unequal. The merus is armed with stout

blunt spines on the inner margin, irregularly dentate on the upper margin, scabrous on the upper portion of the outer surface, and with a line of small tubercles on the lower outer margin; carpus faintly scabrous near the merus, with a strong, blunt spine at the inner angle. Hand inflated; fingers irregularly dentate within, gaping to the tips in the male, in contact in the female. Ambulatory legs flattened, sparingly pubescent; merus joints denticulate above; carpal joints indistinctly denticulate above, with a few spinules on the distal margin; propodal joints with two rows of spines above and below, the lower ones the longer, and one row on the distal margin; dactyls with three rows above and two below, with fewer spines in the lower rows.

Length of larger specimen, a female, 46mm; width, 76. Length of ♂ 21.5; width, 38.

Hayti; A. G. Younglese; ♀ (3216). San Domingo; W. M. Gabb, 1878; ♂ (3192).

Epilobocera granulata.

(Pl. LXXVII, Fig. 6.)

The specimens are smaller than in the preceding species, and are sexually immature. The species is closely allied to *haytensis*. The areolations of the carapace are the same. The anterior portion is more distinctly granulous, especially the epigastric lobes, and the branchial regions are coarsely granulate near the margins. The antero-lateral margin is not interrupted at the cervical suture, but there is a deep sinus next the postorbital tooth, and the first tooth following is very small. The next 6 to 9 teeth are larger and more regular than the remainder. Superior frontal border as in *haytensis*. The inferior frontal border is thin, more advanced than the superior, and in a front view the two halves are seen to arch upward. The external suborbital fissure is very shallow, scarcely more than an interruption of the denticles of the orbital border. The subhepatic and subbranchial regions are granulate, and the cervical ridge is present as in *haytensis*, but the jugal area is smooth, except at the anterior extremity. The epistome has three acute lobes, tuberculate on the margins, similar to those of *haytensis*. The maxillipeds in width exceed the buccal cavity; the merus has the antero-external angle much more arcuate than in *haytensis* (Fig. 6). Abdomen of male narrower than in *haytensis*, especially noticeable in the penultimate segment. The merus and carpus of the chelipeds of the male are similar to those in *haytensis*; the carpal spine is sharper. Hands little dilated; fingers very slightly gaping at their base. Ambulatory legs sparingly pubescent, with meral joints denticulate above; carpal, propodal, and terminal joints armed as in *haytensis*.

Length, 13.5; width, 23 millimeters.

West Indies (6705). Four specimens, all more or less mutilated. Two of them are males, and probably also the other two.

Family TRICHODACTYLIDÆ.

Trichodactylus quinquedentatus.

(Pl. LXXVII, Fig. 7.)

Carapace very convex longitudinally, slightly convex transversely. Surface smooth, shining, punctate, the punctæ irregular in size and numerous. There is an H-shaped depression in the center of the carapace. Front narrower than in *punctatus*, consisting of two broad lobes more pronounced than in specimens of *punctatus* of equal size. External orbital angle obtuse. Lateral margin strongly arcuate, armed with five teeth, besides the orbital, the first three sharp and spiniform, the last two blunt. Carapace widest at the fourth tooth. Frontal, orbital and lateral margins ridged and smooth. Outer margin of merus of maxilliped ridged and more strongly produced at its anterior angle than in *punctatus*. Abdomen of female covering the sternum; terminal segment broadly triangular, rounded at the tip. Chelipeds in female unequal, punctate; merus triangular, upper margin acute, with a tooth at the distal end; lower surface with a small sharp spine on the outer and the inner margin, and a blunt projection at the extremity of the outer margin; carpus with a spine on the inner margin. Hands convex beneath, almost straight above; smaller hand about two thirds as deep as larger; fingers in contact in both hands. Ambulatory legs very slender; meral joints not dilated. Ambulatory legs, fingers, and upper portion of hand and carpus, covered with a close velvety pubescence.

Length, 19; width, 22 millimeters.

Found in a ditch, almost dry, near the Escondido River, 50 miles from Bluefields, Nicaragua, by Charles W. Richmond, August 15, 1892; one female (17726).

T. quinquedentatus can be distinguished from other species by the number of lateral teeth.

EXPLANATION OF PLATES.

(From drawings by Mr. A. H. BALDWIN.)

PLATE LXXIII.

Pseudothelphusa jouyi, ♂, $\times 1\frac{1}{8}$.

PLATE LXXIV.

FIG. 1. *P. jouyi*, five segments of male abdomen, $\times 1\frac{3}{8}$.
2. *P. jouyi*, first abdominal appendage, outer side, $\times 3\frac{1}{8}$.
3. *P. jouyi*, external maxilliped, $\times 1\frac{3}{5}$.
4. *P. dugesi*, carapace of ♂. $\times 1\frac{3}{5}$.
5. *P. dugesi*, first abdominal appendage, outer side, $\times 4$.
6. *P. terrestris*, carapace of ♂, $\times 1\frac{3}{8}$.
7. *P. terrestris*, first abdominal appendage, outer side, $\times 3\frac{1}{5}$.
8. *P. verticalis*, large hand of ♂, $\times 1\frac{1}{3}$.
9. *P. verticalis*, first abdominal appendage, upper side, $\times 2\frac{3}{5}$.
10. *P. colombianus*, carapace of small ♀, $\times 1\frac{3}{5}$.

PLATE LXXV.

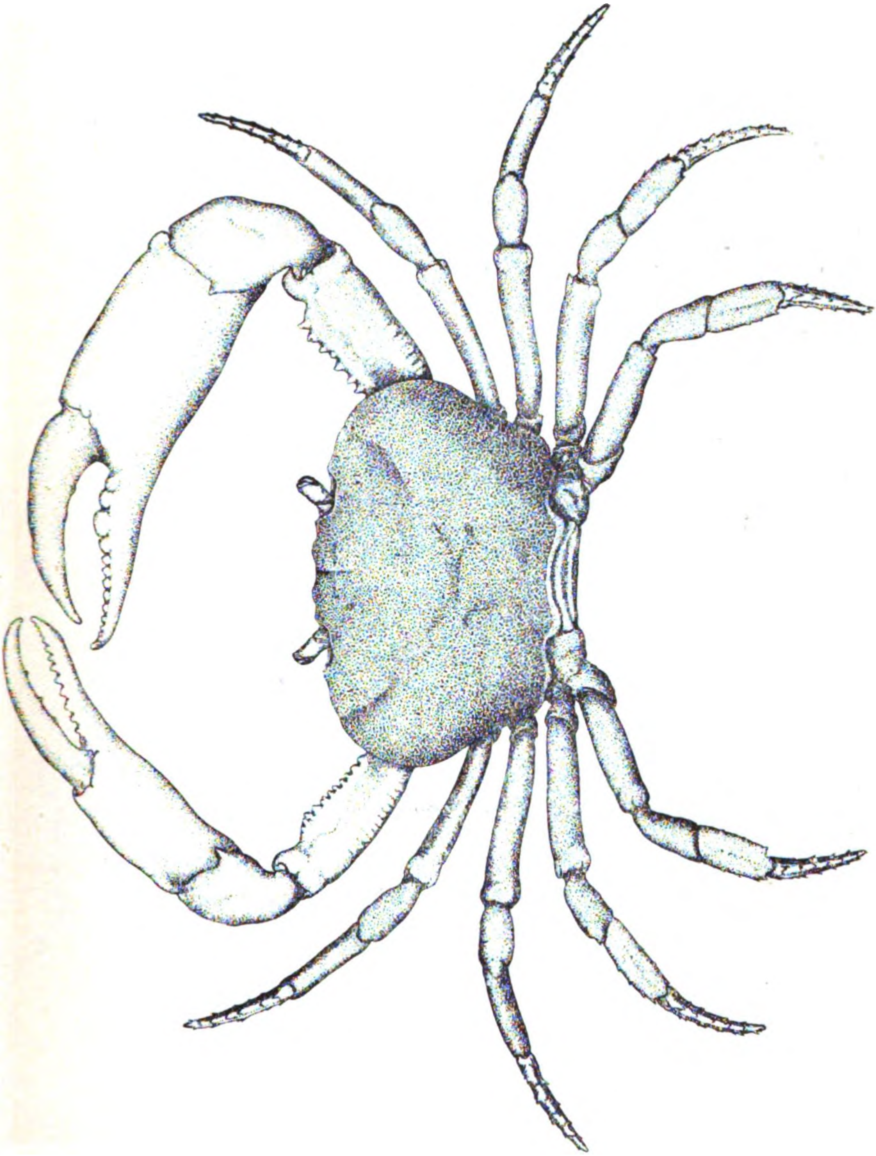
FIG. 1. *P. colombianus*, large hand of ♀, × $1\frac{3}{5}$.
2. *P. lamellifrons*, carapace of ♂, × $1\frac{3}{5}$.
3. *P. lamellifrons*, large hand of ♂, × $1\frac{3}{5}$.
4. *P. lamellifrons*, five segments of male abdomen, × $1\frac{3}{5}$.
5. *P. lamellifrons*, first abdominal appendage, outer side, × $3\frac{1}{5}$.
6. *P. richmondi*, carapace of ♂, × about $1\frac{1}{16}$.
7. *P. richmondi*, five segments of male abdomen, × $1\frac{3}{5}$.
8. *P. richmondi*, first abdominal appendage, outer side, × $2\frac{1}{5}$.
9. *P. richmondi*, external maxilliped, × about $1\frac{1}{16}$.
10. *P. richmondi*, large hand of ♂, × about $1\frac{1}{16}$.

PLATE LXXVI.

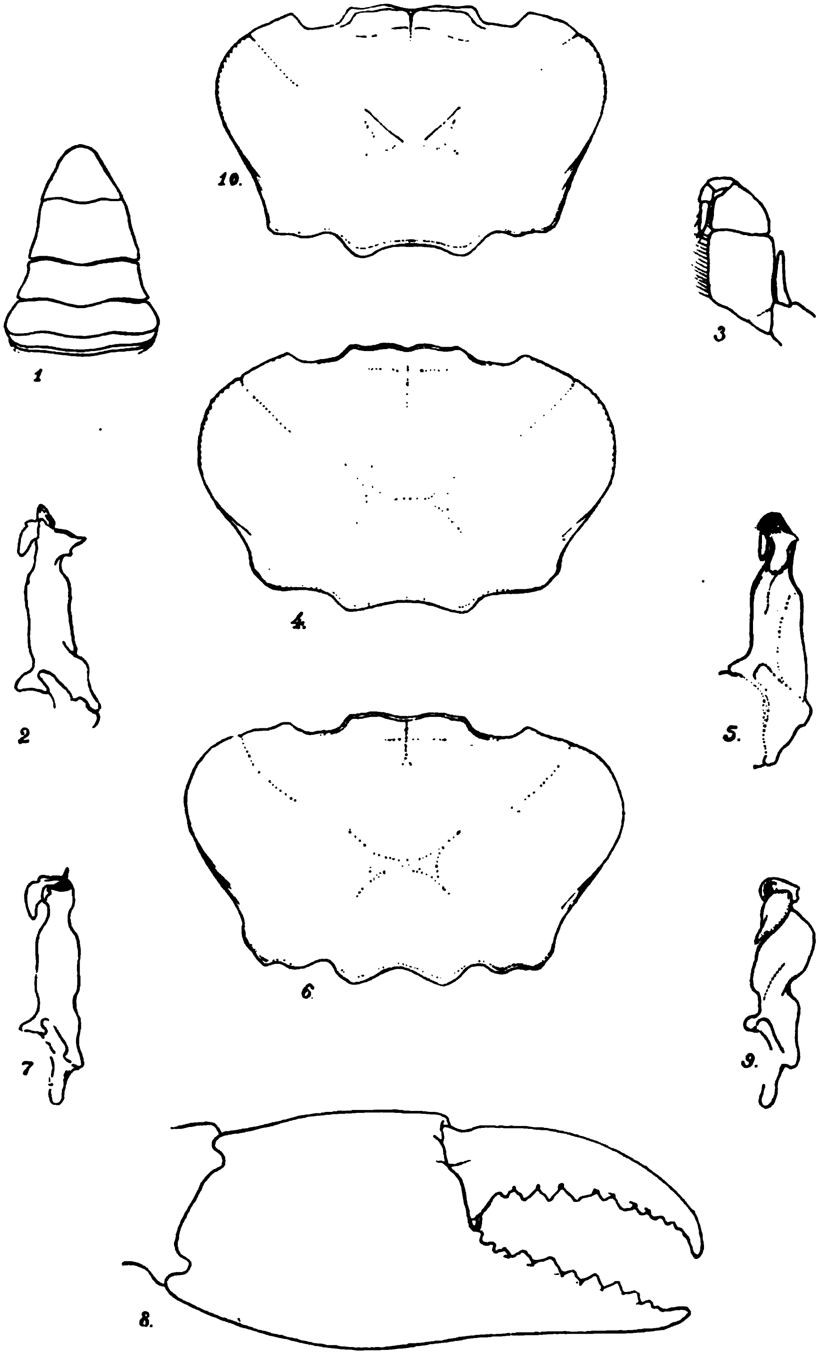
Potamocarcinus nicaraguensis, ♂, × $\frac{11}{16}$.

PLATE LXXVII.

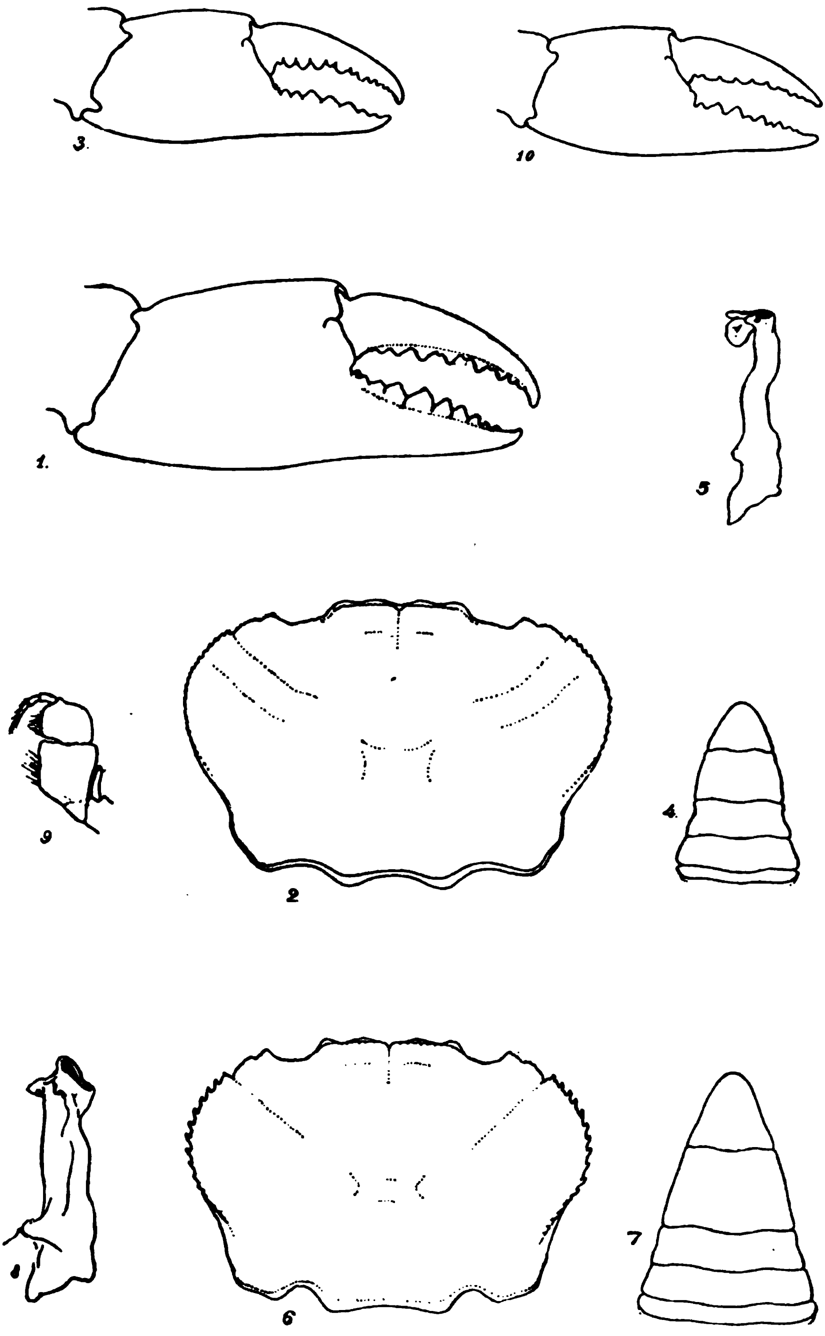
FIG. 1. *P. nicaraguensis*, external maxilliped, × $1\frac{3}{5}$.
2. *P. nicaraguensis*, five segments of male abdomen, × $\frac{4}{5}$.
3. *P. nicaraguensis*, first abdominal appendage, outer side, × $1\frac{2}{5}$.
4. *Epilobocera haytensis*, carapace of ♀, × $\frac{4}{5}$.
5. *E. haytensis*, external maxilliped, × $1\frac{3}{5}$.
6. *E. granulata*, external maxilliped, × $3\frac{1}{5}$.
7. *Trichodactylus quinquedentatus*, ♀, × $1\frac{3}{5}$.



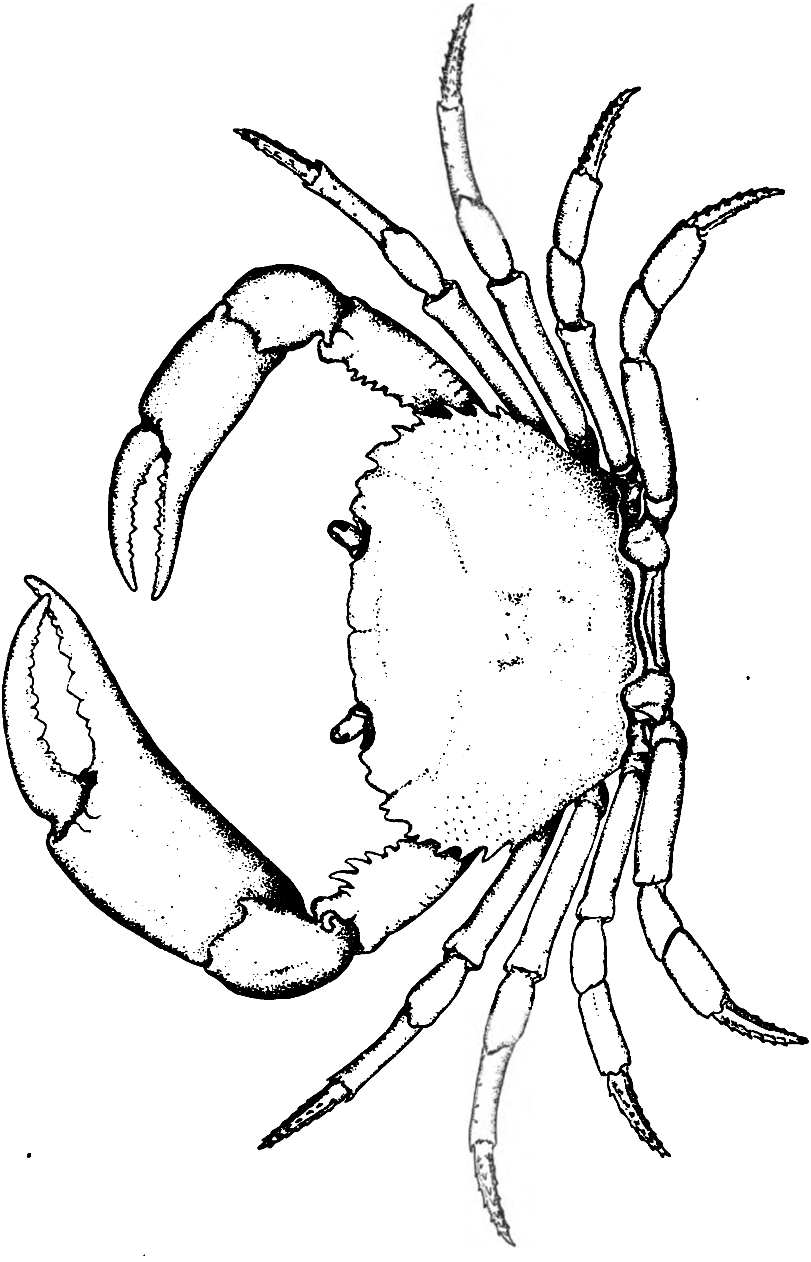
Pseudothelphusa jouyi.



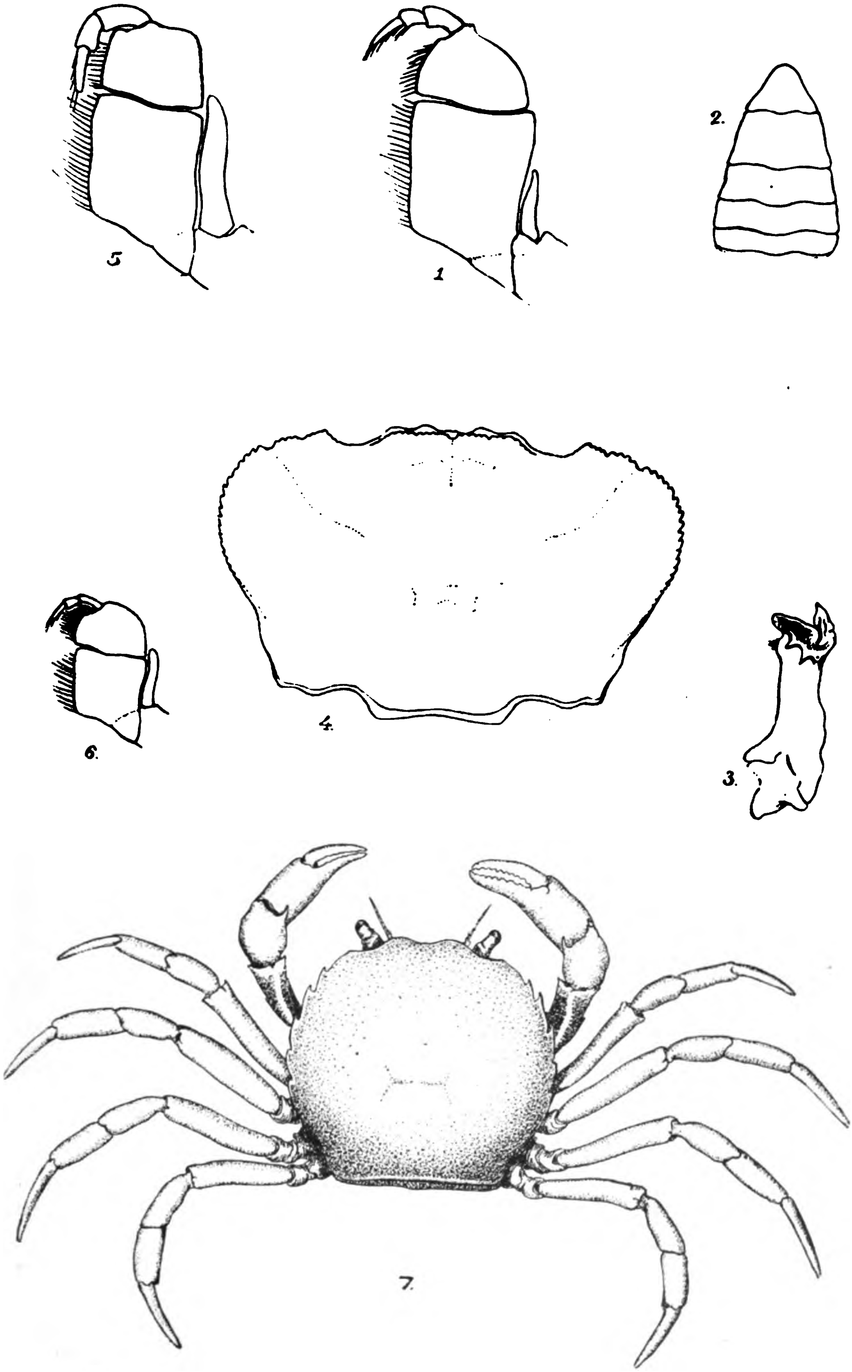
1-3. ***Pseudothelphusa jouyi.***
4, 5. *P. dugesi.*
6, 7. *P. terrestris.*
8, 9. *P. verticalis.*
10. *P. colombianus.*



1. *Pseudothelphusa colombianus.* 2–5. *P. lamellifrons.*
6–10. *P. richmondi.*



Potamocarcinus nicaraguensis



1-3. *Potamocarcinus nicaraguensis.*
6. *E. granulata.*
4. 5. *Epilobocera haytensis.*
7. *Trichodactylus quinquedentatus.*

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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NO. XXVII—CATALOGUE OF A COLLECTION OF BIRDS MADE IN ALASKA BY MR. C. H. TOWNSEND DURING THE CRUISE OF THE U. S. FISH COMMISSION STEAMER *ALBATROSS*, IN THE SUMMER AND AUTUMN OF 1888,*

BY

ROBERT RIDGWAY,

Curator of the Department of Birds.

Family ALCIDÆ.

1. **Lunda cirrhata** Pall. Tufted Puffin. Middleton Island, August 26; one specimen.
2. **Fratercula corniculata** (Naum.). Horned Puffin. Shumagins, August 2; one specimen.
3. **Ptychoramphus aleuticus** (Pall.). Cassin's Anklet. Shumagins, August 4; one specimen.
4. **Simorhynchus cristatellus** (Pall.). Crested Auklet. Big Koninski Island, August 4; two specimens.
5. **Brachyramphus marmoratus** (Gmel.). Marbled Murrelet. Kodiak, August 18, and Barclay Sound, September 27; two specimens.
6. **Cepphus columba** Pall. Pigeon Guillemot. Shumagins, August 2; two specimens.
7. **Uria troile californica** (Bryant). California Murre. Shumagins, August 2; one specimen.

Family STERCORARIIDÆ.

8. **Stercorarius pomarinus** (Temm.). Pomarine Jaeger. Kodiak, August 15; one young bird.
9. **Stercorarius parasiticus** (Linn.). Parasitic Jaeger. Kodiak, August 18; one specimen.

Family LARIDÆ.

10. **Rissa tridactyla pollicaris** Ridgw. Pacific Kittiwake. Middleton Island, August 26; two specimens.

Family DIOMEDEIDÆ.

11. **Diomedea albatrus** Pall. Short-tailed Albatross. "North Pacific Ocean," no date; one specimen.

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*Various circumstances have delayed the publication of this list, which was prepared in 1889.

Family PROCELLARIIDÆ.

12. **Fulmarus glacialis glupischa** Stejn. Pacific Fulmar. Light-house Rock. August 8; two specimens.
13. **Puffinus tenuirostris** (Temm.). Slender-billed Shearwater. South of Unimak Pass, July 29; one specimen.

Family SCOLOPACIDÆ.

14. **Tringa bairdii** (Coues). Baird's Sandpiper. Kodiak, August 15; one specimen.
15. **Tringa minutilla** Vieill. Least Sandpiper. Shumagins, August 1; one specimen.

Family FALCONIDÆ.

16. **Falco columbarius** Linn. Pigeon Hawk. Kodiak, August 15; one specimen.

Family BUBONIDÆ.

17. **Asio accipitrinus** (Pall.). Short-eared Owl. Unalashka, July 28; one specimen.

Family PICIDÆ.

18. **Ceophlœus pileatus** (Linn.). Pileated Woodpecker. "Alaskan cruise, October '92"; one specimen

Family CORVIDÆ.

19. **Corvus caurinus** Baird. Northwest Crow. Barclay Sound, September 27; one specimen.
20. **Pica pica hudsonica** (Sab.). American Magpie. Shumagins, August 2; one specimen.

Family FRINGILLIDÆ.

21. **Leucosticte griseonucha** (Brandt). Aleutian Leucosticte. Unalashka, July 27; two specimens.
22. **Acanthis linaria** (Linn.). Redpoll. Kodiak, August 11; one specimen.
23. **Calcarius lapponicus** (Linn.). Lapland Longspur. Shumagins, August 1; one specimen.
24. **Ammodramus sandwichensis** (Gmel.). Kodiak, August 11; Unalashka, July 27; Middleton Island, August 26; six specimens.
25. **Zonotrichia coronata** (Pall.). Golden-crowned Sparrow. Shumagins, August 2; Kodiak, August 11 and 15; three specimens.
26. **Melospiza cinerea** (Gmel.). Aleutian Song Sparrow. Kodiak, August 15 and 17; two specimens.
27. **Passerella iliaca unalaschensis** (Gmel.). Townsend's Sparrow. Kodiak, August 11–17 (six specimens); Middleton Island, August 26; two specimens.

Family MNIOTILTIDÆ.

28. **Dendroica æstiva** (Gmel.). Yellow Warbler. Middleton Island, August 26; three specimens.
29. **Sylvania pusilla pileolata** (Pall.). Pileolated Warbler. Kodiak, August 11; one specimen.

Family TROGLODYTIDÆ.

30. **Troglodytes hiemalis pacificus** Baird. Western Winter Wren. Kodiak, August 15 and 19; two specimens.

A young bird in first plumage may be described as follows:

Young (No. 115795, U. S. Nat. Mus., Kodiak, August 17, 1888; C. H. Townsend): Above plain bister-brown, duller on top of head, brighter posteriorly, the upper tail-coverts inclining to Vandyke-brown; wings

and tail brighter brown (very nearly a medium tint of Vandyke), barred with dusky, the primaries dusky spotted with pale buffy brown or light brownish buff. A very indistinct superciliary stripe of pale brownish. Chin and throat dull buffy-grayish; breast and belly dull light buffy-brownish, the feathers indistinctly margined with grayish dusky; sides and flanks more decidedly brown, especially the latter, which are rather broadly barred with dusky; lower belly similarly barred, but ground-color paler (like color of breast, etc.); under tail-coverts light Vandyke-brown, each with a central sagittate spot of dusky. Bill and feet as in the adult.

31. **Troglodytes alascensis** Baird. Alaskan Wren. Unalashka, July 27; two specimens.

Family PARIDÆ.

32. **Parus atricapillus septentrionalis** (Harris). Long-tailed Chickadee. Kodiak, August 15 and 17; two specimens.

Family SYLVIIDÆ.

33. **Regulus satrapa olivaceus** Baird. Western Golden-crowned Kinglet. Kodiak, August 15 and 17; two specimens.

Family TURDIDÆ.

34. **Turdus aonalaschkæ** Gmel. Dwarf Hermit Thrush. Kodiak, August 15 and 17; four specimens.

35. **Hesperocichla nævia** (Gmel.). Varied Thrush. Kodiak, August 15; two specimens.

A REVISION OF THE GENUS FORMICARIUS BODDAERT.

BY
ROBERT RIDGWAY,
Curator of the Department of Birds.

The present attempt to elucidate the species and local forms of the Genus *Formicarius* was brought about by a peculiar combination of circumstances. The U. S. National Museum has for a long time possessed specimens of two forms from Central America, one represented by specimens from Costa Rica and Nicaragua, the other by examples from Panama; and, although unquestionably distinct forms, all were labelled "*Formicarius hoffmanni.*" Further, while *F. hoffmanni* was described from a Costa Rica specimen, the description made it clear that the Panama birds in the National Museum and not those from Costa Rica represented that species, a fact to be explained only on the supposition that this Panama form extended into some part of Costa Rica from which the National Museum had no specimens, perhaps, on the Pacific side, a hypothesis which specimens recently received from the Costa Rica National Museum have proven to be correct. To add to my perplexity, the leading authorities on Neotropical ornithology ascribed another species (*F. analis*) to Costa Rica which could not be recognized among the many specimens examined. In short, I found it quite impossible to properly label the material examined with the assistance of Volume XV of the "Catalogue of Birds in the British Museum," or that portion of the *Biologia Centrali-Americana*, *Aves*, including this genus.

After bringing together a series of nearly sixty specimens, however, from various collections, the matter is made quite clear regarding a number of doubtful points, though the material is still far from adequate for a satisfactory treatment of the subject, immense areas of South America and considerable portions of Central America being absolutely unrepresented.

As one result of this accumulation of material, it has been ascertained that three very distinct forms of the *analis* section of the genus occur in Costa Rica, the commonest of which, or at least the one having the most extensive range there, appears to have been universally confounded with *F. hoffmanni*, while that referred to *F. analis*, is really not that species at all, but a very distinct one, ranging from Costa Rica to western Ecuador, which Mr. Cherrie has named, in manuscript, *F. nigricapillus*. It is also found that between *F. hoffmanni* and *F. crissalis*, or in the district extending from the island of Trinidad through Venezuela to the interior of Colombia, is interposed a form of somewhat in-

termediate but definite and very constant characters, which I have named *F. saturatus*. Of *F. crissalis* I have seen but one specimen; of *F. analis* only two (possibly three), and none of *F. rufipectus* or its near ally (possibly not different), *F. thoracicus*.

In the case of few specimens of a given form, or what are supposed to be the same form, it is of course difficult to tell whether certain obvious differences represent individual or local variations; but, as has so often been the case in other instances, it has been found that the larger the series of specimens the more uniform are their characters, and consequently the various local forms thus represented can be more easily defined.

My thanks are due for the loan of specimens to the authorities of the Museo Nacional de Costa Rica, the Boston Society of Natural History, the American Museum of Natural History, New York City, and Messrs. Salvin and Godman, of London, England, all of whom have lent me important specimens, without which no satisfactory conclusions could have been reached. The considerable series of specimens which I have thus been able to bring together suggests very strongly the probability that *F. analis* (Lafr. & D'Orb.), *F. crissalis* (Cab.), *F. hoffmanni* (Cab.), *F. moniliger* Scl., and the three forms which I am obliged to describe as new, are not distinct species, but merely more or less differentiated geographical races of one widely distributed species, which ranges from southern Mexico to Bolivia; and that when we have specimens from the very considerable areas of continental tropical America from which examples of the genus have not yet been examined it will become necessary to characterize and name still other forms. However this may prove to be, I find that the ten forms of the *F. analis* section treated below can easily be made out from the comparatively scant material which I have been able to compare:*

* The following table will show the number and source of the specimens examined in the preparation of this paper:

No.	Species.	Collection.					
		U. S. National Museum.	Costa Rica National Museum.	American Museum Natural History.	Boston Society Natural History.	Collection Messrs. Salvin and Godman.	Collection C. W. Richmond.
1	F. cayanensis Bodd	2	......	2	......	......	......
2	F. nigrifrons Gould	2	......	3	......	......	......
3	F. analis (Lafr. & D'Orb.)	......	......	1	......	2	......
4	F. nigricapillus Cherrie	1	......	......	......	2	......
5	F. crissalis (Cab.)	......	......	......	......	1	......
6	F. saturatus Ridgw	1	......	11	(?) 1	2	......
7	F. hoffmanni (Cab.)	3	4	4	(?) 1	3	......
8	F. umbrosus Ridgw	8	9	......	......	......	4
9	F. moniliger Scl	2	......	3	......	3	......
10	F. pallidus Lawr	......	......	1	......	1	......
11	F. rufipectus Salv	......	......	......	......	......	......
12	F. thoracicus Tacz. & Berl	......	......	......	......	......	......
	Total	19	13	25	2	14	4

Genus FORMICARIUS Boddaert.

Formicarius Bodd. Tabl. P. E. 1783, 43. Type, *F. cayanensis* Bodd.
"*Myrmornis* Herrm. Tab. Affin. Anim. 1783, 235." Type.
Myrmecophaga Lacép. Mém. l'Inst. Paris, III, 1801, 507. Type undeterminable.
Myiothera Illig. Prodr. 1811, 218. Type, *Turdus colma* Gm., = *Formicarius cayanensis* Bodd.
Myrmothera, part, Vieill. Analyse, 1816, 43, 70. Type (none specified, and no species named; includes "Befroi, et quelques autres fourmilliers de Buffon").
Myocincla Swains. Classif. B. II, 1837, 230. Type, *Turdus colma* Gmel., = *Formicarius cayanensis* Bodd.

Gen. Char.—Wing exceeding tail in length by at least the length of the tarsus, much rounded (first quill shortest, third to fifth longest), the primaries strongly curved. Tail rounded, the difference between the shortest and longest feathers about equal to length of gonys or a little less. Tarsus about two and a half times as long as bill from nostril, distinctly scutellate on both anterior and posterior divisions. Middle toe more than half as long as tarsus. Inner toe with the tip of its claw reaching to or slightly beyond base of middle claw; outer toe a little shorter, its basal phalanx united to middle toe; hind toe decidedly shorter than lateral toes, but with claw nearly as long as the digit. Bill shorter than head (exposed culmen about as long as distance from nostril to posterior angle of eye), slightly compressed anteriorly, somewhat depressed at base, the tip obviously notched. Nostrils exposed, obliquely longitudinal, with overhanging membrane. Rictal bristles short, inconspicuous. Eyes large, the region immediately behind and beneath naked. Plumage normally compact; general color uniform brown above (the head sometimes rusty or black); dusky, grayish, or brownish below, sometimes with the chest rusty, the under tail coverts also usually rusty, and the throat black; inner webs of remiges with basal portion buffy, ochraceous, or tawny, the under wing coverts similar, but tipped with black.

The genus most nearly related to *Formicarius* is, apparently, *Phlogopsis* Reichenbach, with which it is compared by Mr. Salvin (Proc. Zool. Soc., London, 1866, p. 73), as follows:

The genus *Formicarius* seems well defined, and separable from the allied forms by several trenchant characters. The plumage consists of short, moderately firm feathers, giving the bird a compact appearance very different from that of *Phlogopsis*, all members of which genus have softer and longer feathers, more like those of *Pithys* and its affines. The region behind the eye is naked; in *Phlogopsis* the entire circlet is bare. The supranasal feathers of *Formicarius* are short and compact; in *Phlogopsis* they are long and prominent. The scutellæ of the tarsi of the former are distinct and divided, while *Phlogopsis* has a single shield on the front of the tarsus. The nostril of *Formicarius* is oblong and situated nearer the base of the bill than that of *Phlogopsis*, which is round. The hind claw is longer and less curved. The tail is shorter, stiffer, and less rounded.

KEY TO THE SPECIES.

a^1. Top of head and hind neck rufescent or tawny, conspicuously different from color of back; outer web of exterior feather of alula light tawny or buff.

b^1. Forehead bright tawny or rufescent, like crown, etc. (Brazil.) .1. *F. cayanensis.*
b^2. Forehead black or dusky. (Amazon Valley.) ....2. *F. nigrifrons.*
a^2. Top of head dull brownish, not conspicuously different from color of back or else black; outer web of exterior feather of alula grayish brown.
b^1. Chest black or some shade of grayish or grayish brown.
c^1. Sides of neck similar in color to hind neck, not rufescent or cinnamomeous.
d^1. Top of head brown, like back, with only centers of feathers blackish; chest slate-gray, in contrast with black of throat; smaller. (Upper Amazon Valley, Bolivia to northeastern Peru.) ....3. *F. analis.*
d^2. Top of head, also chest, black; larger. (Pacific coast district, from western Ecuador to Costa Rica.) ....4. *F. nigricapillus.*
c^2. Sides of neck rufescent or cinnamomeous.
d^1. Under tail coverts wholly tawny, rusty, or chestnut.
e^1. Forehead concolor with crown,—not rufescent.
f^1. White loral spot large, conspicuous; under parts clear brownish gray, becoming nearly white on belly; under tail coverts clear tawny. (British Guiana.) ....5. *F. crissalis.*
f^2. White loral spot small, sometimes obsolete; under parts nearly uniform deep brownish gray; under tail coverts rufous-tawny. (Trinidad, Venezuela, and coast of Colombia.) ....6. *F. saturatus.*
e^2. Forehead distinctly rufescent, different from crown. (Under tail coverts as in *F. crissalis;* general color of under parts much browner than in either *F. crissalis* or *F. saturatus.*) (Isthmus of Panama, north to western Costa Rica.) ....7. *F. hoffmanni.*
d^2. Under tail coverts only partly (if at all) tawny, rusty, or chestnut, the longer (posterior) feathers being dusky margined with brown.
e^1. No rusty collar across fore neck. (Eastern Costa Rica and Nicaragua.) ....8. *F. umbrosus.*
e^2. A distinct rusty collar across fore neck.
f^1. Darker; rusty brown above, the pileum much darker. (Eastern Mexico, Guatemala, and British Honduras.)................9. *F. moniliger.*
f^2. Paler; light grayish brown above, the top of head not darker. (Yucatan.)..10. *F. pallidus.*
b^2. Chest rufous or chestnut.
c^1. Top of head rusty brown; chest chestnut-rufous. (Veragua; Ecuador.) ....11. *F. rufipectus.*
c^2. Top of head black; chest dark rufous or chestnut. (Eastern Ecuador.) ....12. *F. thoracicus.*

Formicarius cayanensis Boddaert.

Formicarius cayanensis BODD., Tabl. P. E., 1783, 50 (based on Le Têtema, de Cayenne Buff., P Enl., 821).—GRAY, Gen. B., I, 211; Hand-l. I., 1869, 298, No. 4418.—SCL., P. Z. S., 1857, 46 (Guiana; Brazil); 1858, 277 (Cayenne; Brit. Guiana; north and southeast Brazil).

Formicarius cayennensis SCL., Catal. 1862, 190 (Brazil).—SALV., P. Z. S., 1866, 74 (Guiana; Cayenne; Brazil).—PELZ., Orn. Bras., II, 1868, 168 (Brazil).—SCL. and SALV., Nom. Neotr., 1873, 75.

Myrmornis cayennensis CAB. and HEINE, Mus. Hein., II, 1859, 7 (Brazil).

Turdus colma GMEL. S. N., I, 1788, 827.

Myrmothera colma VIEILL, Enc. Méth., 1723, 681, 683.

Myiothera colma CAB. in Schomb. Guiana, III, 1848, 686., BONAP.—Consp., I, 1850, 205 (s. Brazil).

Formicarius colma SCL., Cat. B. Brit. Mus., XV, 1890, 302 (Saô Paulo, Bahia, and southeast Brazil; Peru?)

Myrmothera tetema VIEILL., Enc. Méth., 1823, 683.

Myioturdus tetema MAX., Beitr., III, pt. 2, 1831, 1038.—MÉNÉTR., Mem. Ac. St. Peters. sér. vi (Sc. Nat.), 1835, 466.

Myiothera tetema BONAP., Consp. I, 1850, 205 (Cayenne: north Brazil).—BURM., Syst Ueb. III, 1856, 46.

Myrmothera fuscicapilla VIEILL., N. D., XII, 1817, 112; Enc. Méth., 1823, 681.

Myiothera ruficeps SPIX, Av. Bras., I, 1823, 72, pl. 72, fig. 1.

Formicarius ruficeps PELZ. Orn. Bras., II, 1868, 90, 168 (Walde do.Cravari, Matto. Grosso; Boden; Borba; Pará).

HAB.—Southeastern Brazil (Saô Paulo; Bahia).

SP. CHAR.—Entire pileum and hind neck bright rufous-tawny (paler laterally, often clouded with dusky medially); sides of head (including lores and superciliary region), chin, throat, and chest black, changing gradually into sooty grayish brown or dull sooty slate on under parts of the body; upper parts olivaceous, the tail blackish terminally, the outer web of external feather of alula and basal portion of remiges and under wing coverts buff or pale tawny.

Adult male (No. 32871, U. S. Nat. Mus., "Brazil"; E. Verreaux):—Pileum and hind neck russet-tawny, paler (light ochraceous) laterally, the median portion clouded with darker by the showing through of the dusky bases of the feathers; rest of upper parts plain grayish olive; the outer webs of the remiges inclining to Prout's brown, and the terminal half (approximately) of the tail blackish brown; outer web of exterior feather of alula ochraceous-buff; primary coverts plain blackish brown; under wing coverts buff, tipped with brownish black, the larger (more posterior) feathers almost wholly of the latter color; inner webs of remiges ochraceous-buff for basal third or more. Sides of head (including lores and superciliary region), sides of neck, chin, throat, and chest black; remaining under parts dull brownish gray, tinged with olive laterally, the ventral region suffused with grayish white. Bill, black; legs and feet, brownish. Total length (skin), 7.10; wing, 3.20; tail, 2.20; exposed culmen, 0.62; tarsus, 1.18; middle toe, 0.72.

"Lores and throat varied with whitish." (SCLATER.)

The series which I have been able to examine of this species is very unsatisfactory. There are only four specimens, all adults, but only one of them sexed.

An example in the National Museum collection, supposed to be from Santa Catarina, Brazil (No. 24049, Lemuel Wells, coll.), is essentially like the one described above, but has the colors rather deeper throughout, the rusty color of pileum, etc., richer, the upper parts more decidedly olive, and the lateral under parts much more olivaceous. Wing, 3.30; tail, 2.20; tarsus, 1.18: middle toe, 0.75.

Two specimens from Bahia in the collection of the American Museum of Natural History are similar in color to the example described above, except that the color of the pileum is much brighter and more uniform—rich rufous-tawny, passing into ochraceous along the edges—

with little, if any, visible clouding of dusky along the median line. Their measurements are as follows: No. 43537: Length (skin), 6.75; wing, 3.45; tail, 2.10; exposed culmen, 0.70; tarsus, 1.23; middle toe, 0.72. No. 43538: Length (skin), 6.10; (tail not grown out); wing, 3.40; exposed culmen, 0.68; tarsus, 1.25; middle toe, 0.75.

2. Formicarius nigrifrons Gould.

Formicarius nigrifrons GOULD, Ann. N. H., ser. 2, XV, May, 1855, 344 (Chamicuros, e. Peru; mus. J. Gould); P. Z. S., 1855, 68 (Chamicuros).—SCL., P. Z. S., 1855, 145 (Bogota); 1857, 47 (Colombia; Amazonia); 1858, 68 (Rio Napo, e. Ecuador); 277 (Colombia; e. Peru); Catal., 1862, 190 (Bogota); Cat. B. Brit. Mus., XV, 1890, 303 (Cayenne, Brit. Guiana, Bogota, Sarayacu, e. Ecuador, Chamicuros, e. Peru).—SALV., P. Z. S., 1866, 74 (e. Peru; Colombia); Ibis, 1885, 429 (Camacusa, Brit. Guiana).—SCL. and SALV., P. Z. S., 1873, 277 (e. Peru); Nom. Neotr., 1873, 75 (Colombia; e. Peru).—TACZAN., P. Z. S., 1882, 32 (n. e. Peru); Orn. du Pér., II, 1884, 77 (Yurimaguas and Chamicuros, e. Peru).

Myrmornis nigrifrons CAB. and HEINE, Mus. Hein., II, 1859, 7 (Cayenne).

Formicarius cayanensis (nec BODD.) PELZ., Orn. Bras., 1868, 90, 168 (Rio Negro, Maribatanas, Barra Mai, and Rio Brancho).

HAB.—Guiana to the Amazon and Colombia.

SP. CHAR.—Similar to *F. cayanensis* BODD., but with whole forehead glossy black.

Adult male (No. 32872, U. S. Nat. Mus., Rio Napo, e. Ecuador; E. Verreaux).—Entire forehead and lores glossy black; sides of head (including narrow superciliary line), sides of neck, chin, throat, chest, and breast "dead" black; rest of under parts dark sooty gray, the anal region mixed with whitish. Crown, occiput, nape, and hind neck deep rufous-tawny, paler, or more ochraceous, laterally, darker (almost chestnut) on the crown, where the feathers are blackish immediately beneath the surface; rest of upper parts clear bister-brown, the tail darker, inclining to brownish black on about the terminal half; outer web of outermost feather of alula deep buff; primary coverts wholly brownish black; basal third (approximately) of inner webs of primaries ochraceous-buff; smaller under wing coverts light buff, tipped with blackish, the larger coverts chiefly blackish. Bill, black; legs and feet, brown. Total length (skin), 6.00; wing, 3.15; tail, 1.95; exposed culmen, 0.60; tarsus, 1.15; middle toe, 0.70.

Young male (No. 16718, Amazon R., Lieut. Herndon, U. S. N.).—Similar to the adult, but forehead less extensively black, the lores and suborbital region largely rusty, chin and throat white squamated with black, chest dark sooty brownish gray, rest of under parts lighter and duller brownish gray than in adult, and upper parts browner (ranging from clear bister on back to mummy brown on upper tail coverts).

Three adults from British Guiana in the collection of the American Museum of Natural History differ from the single example from the upper Amazon (Rio Napo) in much larger bill and in having a distinct

plumbeous cast to the under parts, even the chest being washed with this color. They measure as follows:

No.	Locality.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe.
43534	British Guiana	3.20	1.90	0.72	1.17	0.70
43535	Cayenne	3.32	1.82	0.70	1.22	0.75
43536	British Guiana	3.20	1.90	0.75	1.10	0.65

Whether the Guiana and Upper Amazon birds thus differ constantly I am unable to state with certainty; but in view of the great uniformity in coloration in the three Guiana birds and their constantly much larger bills I have little doubt that such will prove to be the case, and therefore propose, provisionally, the name *Formicarius nigrifrons glaucopectus** for the Guiana bird.

3. Formicarius analis (Lafresnaye).

Myothera analis LAFR.,† Mag. de Zool., 1837 ("Synopsis Avium"), Cl. II, p. 14 (Yuricares et Chiquitos, Bolivia).—D'ORB., Voy. Ois., "1835–1844," 191, pl. 6 *bis*, fig. 1.

? *Myiothera analis* BONAP. Consp. I, 1850, 205 (Brazil).

Formicarius analis SCL., P. Z. S., 1857, 46, part (Bolivia); 1858, 277, part (Bolivia); Cat. B. Brit. Mus., XV, 1890, 304, part (locs. in e. Peru and e. Ecuador).—SALV., P. Z. S., 1866, 74, part (Bolivia).—SCL. and SALV., P. Z. S., 1867, 751 (Xeberos and Chyavetas, e. Peru); Nom. Neotr., 1873, 75, part (Bolivia).—TACZAN., P. Z. S., 1882, 32 (Huambo, n. e. Peru); Orn. Pér., II, 1884, 78 (Yurimaguas, Xeveros, Chayavetas, Huambo, and Paucal, e. Peru).—ALLEN, Bull. Am. Mus., N. H., II. No. 2, 1889, 98 (Yungas, Bolivia).—SALV. and GODM., Biol. Centr. Am. Aves, II, pt. 29, 1892, 235, part (Bolivia).

HAB.—Bolivia and eastern Peru.

SP. CHAR.—Whole top of head olivaceous-brown, like back, but centers of feathers dusky; sides of neck similar in color to top of head, but rather lighter—not at all inclining to cinnamomeous or rufous; under tail coverts varying from bright rufous-tawny to tawny-chestnut—always uniform.

Adult female (coll. Salvin and Godman, Yquitos, Bolivia, August 24, 1878, H. Whitely).—Feathers of pileum dull blackish broadly margined with sepia-brown, producing a scaled appearance; rest of upper surface clear olive-sepia or bister, deepening into a warmer brown (approaching Vandyke brown) on secondaries and brightening into almost mummy brown on upper tail coverts; outer web of exterior feathers of alula deep broccoli brown; primary coverts, wholly blackish dusky; tail blackish brown terminally, browner basally. Lores, suborbital and malar regions, chin, and throat dull black, the first with

* Type, No. 43536, Am. Mus. Nat. Hist., British Guiana; Alexander.

† "LAFR. et D'ORB." are usually quoted as the describers of this species, but the former only can properly be considered as its describer. It is true that Lafresnaye, in the article cited above, quotes "D'Orb., Voy dans l'Amér. merid., pl. 6 *bis*," but neither this plate nor the description in D'Orbigny's "Voyage" were published until several years after the publication of Lafresnaye's description.

an indistinct central spot of white; sides of neck light bister, like hind neck. Chest dull slate color, the remaining under parts (except under tail coverts) lighter gray, tinged with olive on sides and flanks and inclining to whitish gray on lower part of belly. Under tail coverts wholly clear deep tawny. Bill, blackish; legs and feet, horn color. Total length (skin), 6.40; wing, 3.52; tail, 2.18; exposed culmen, 0.75; tarsus, 1.20; middle toe, 0.72.

An adult in the collection of the American Museum of Natural History (No. 30700 *bis.*) from Yungas, Bolivia, altitude 6,000 feet, (H. H. Rusby) is brighter bister brown above, with the dark centers of the feathers of the pileum far less distinct; the white loral spot much larger; the sides of the neck and postocular region appreciably different in hue from the hind neck and other upper parts (deep wood brown instead of light bister) and the under parts are paler and less pure gray, the entire chest, as well as sides and flanks, being strongly tinged with light brownish. The under tail coverts, however, are colored exactly as in the Yquitos specimen. Length (skin), 6.50; wing, 3.40; tail, 2.00; exposed culmen, 0.70; tarsus, 1.22; middle toe, 0.72.

What will doubtless prove a local form of this species, aproaching *F. nigricapillus* CHERRIE in its characters, is represented in the collection of Messrs. Salvin and Godman by an adult from Sarayacu, northeastern Peru (C. Buckley). This differs from the Bolivian specimens in its much darker coloration throughout, the upper surface ranging from dark sepia on the head to mummy brown on upper tail coverts, the under parts ranging from dark sooty slate on the chest to deep olive-gray on sides and flanks. The under wing coverts and axillars have their basal portion bright tawny, and the under tail coverts, instead of being deep clear tawny, are rich chestnut. The white loral spot is about as well developed as in the Yquitos specimen. Total length (skin), 5.70; wing, 3.57; tail, 2.05; exposed culmen, 0.72; tarsus, 1.25; middle toe, 0.71.

Of this very easily recognized form I have seen three specimens, all mentioned above. These agree minutely, in essential features, with the original description and colored figure by Lafresnaye and D'Orbigny, in which the cinnamomeous coloring on the sides of the neck in all the related species (except *F. nigricapillus* CHERRIE) is conspicuously absent, and no doubt represent the true *F. analis*. In the Lafresnaye collection, for sometime the property of the Boston Society of Natural History, are the alleged types of *F. analis;* but they certainly are *not* the types of that species, since they unquestionably belong to the forms subsequently separated as *F. crissalis* by Cabanis and *F. saturatus* by the author of the present paper, and are probably from Guiana or lower Amazonia and some part of Colombia, respectively. (See remarks under *F. crissalis* and *F. saturatus*, on pages 671 and 679)

According to D'Orbigny, the naked postocular space is whitish in life, the eyes red, and the feet violet; but Taczanowski (Orn. Pér., II,

p. 78) gives the fresh colors of an adult female from Yurimaguas as follows: "Bill, horn-black; feet, gray; iris, deep brown."

4. **Formicarius nigricapillus** Cherrie.

Formicarius analis (nec *Myothera analis* LAFR.) SCL. P. Z. S. 1860, 294 (Babahoyo, w. Ecuador); Cat. 1862, 190 (Esmeraldas, w. Ecuador); Cat. B. Brit. Mus. XV, 1890, 304, part (Esmeraldas, Balzar Mts., and Sta Rita, w. Ecuador).—SALV. P. Z. S. 1866, 74, part (Costa Rica; Veragua); 1867, 145 (Sta Fé, Veragua).—LAWR. Am. Lyc. N. Y., IX, 1868, 110 (Veragua).—SCL. and SALV. Nom. Neotr., 1873, 75, part (Panama; Costa Rica).—SALV. and GODM. Biol. Centr.-Am., Aves, II, pt. 30, 1892, 235, part (Tucurrique, Costa Rica; Veragua; w. Ecuador).—TACZAN and BERL. P. Z. S. 1885, 118 (Esmeraldas, w. Ecuador).

HAB.—Costa Rica to western Ecuador.

SP. CHAR.—Similar to *F. analis* (LAFR.) in the entire absence of rufous on sides of neck, etc., but larger (the bill conspicuously so), and very much darker throughout in coloration, the entire head and fore neck (sometimes chest also) being deep black, instead of this color being confined to cheeks and throat.

Adult male (Coll. Salvin and Godman, Costa Rica, 1869, J. Carmiol).—Entire head (including whole of the lores), neck (except hind neck) and chest deep black, fading gradually on the breast into dark sooty slate color, this fading into dull sooty slate on sides of abdomen, the middle of the belly paler and browner, the sides and flanks strongly washed with olivaceous; under tail coverts bright russet, becoming gradually darker on the more posterior feathers, the longest of which are mainly dusky blackish with their tips and edges mummy brown; under wing coverts and axillars buff (varying in intensity on different feathers) each feather broadly and abruptly tipped with black; remiges with the basal portion of their inner webs dull cinnamon. Upper parts, including hind neck, rich dark brown (intermediate between "mummy" and "bister," the feathers brownish black beneath surface), changing gradually to deep chestnut on upper tail coverts and to a less reddish hue (nearly pure "bister") on outer webs of wing coverts and tertials; outer webs of remiges (except tertials) grayish brown. Tail brownish black. Bill entirely deep black; legs and feet brownish. Total length (skin), 7.50; wing, 3.70; tail, 2.00; exposed culmen, 0.90; tarsus, 1.30; middle toe, 0.82.

Adult female (type, No. 128852 *, U. S. Nat. Mus., Buena Vista, Costa Rica, August 16, 1892, Castro y Fernandez).—Similar to the male, as described above, but upper surface not quite so bright a brown, the breast and sides of belly more slaty, and under tail coverts rather paler; legs and feet brownish black. Total length (contracted skin), 6.40; wing, 3.55; tail, 2.02; exposed culmen, 0.90; tarsus, 1.15; middle toe, 0.85.

An adult (sex not indicated) from Sta Rita, western Ecuador, in the collection of Messrs. Salvin and Godman ("Villagomez, per C. Buck-

* No. 8284, Museo Nacional de Costa Rica.

ley") is most like the female from Costa Rica but is even less castaneous or rufescent above (nearly pure "bister" on the back) and more extensively slaty beneath, while the hind neck, instead of being similar in color to the back (as in both Costa Rica specimens), is dark slate color, like the chest, and the under tail coverts bright rufous-tawny. It very likely represents a local race. Its measurements are as follows: Total length (skin), 7.00; wing, 3.70; tail, 2.28; exposed culmen, 0.89; tarsus, 1.30; middle toe, 0.80.

This species undoubtedly comes nearest to *F. analis* (Lafr.), which replaces it in Bolivia and eastern Peru (and eastern Ecuador?), but may be easily recognized by its perfectly black pileum (the whole top of the head in *F. analis* being olive-brownish, like the back), darker under tail coverts with their longer feathers chiefly dusky, and decidedly larger size, the bill especially. From the other two species found in Costa Rica it may at once be distinguished, in addition to its black pileum, by the entire absence of any cinnamomeous coloring about the head or neck, and by the absence of any trace of white on the lores.

5. Formicarius crissalis (Cabanis).

Myiothera analis (nec LAFR.) CAB. in Schomb. Guiana, III, 1848, 686 (Roraima, Br. Guiana).

Formicarius analis SCL. P. Z. S. 1858, 277, part (Cayenne; Brit. Guiana; Para?).

Myrmornis crissalis CAB. J. f. O. 1861, 96 (Roraima).

Formicarius crissalis SCL. and SALV. P. Z. S. 1867, 576 (Pará).—SALV. P. Z. S. 1866, 75, part* (Guiana; Cayenne; Pará).—SCL. Cat. B. Brit. Mus. XV. 1890, 305, part (Cayenne; Guiana).—SALV. and GODM. Biol. Centr.-Am., Aves, II, pt. 30, 1892, 234, in text (Guiana).

Formicarius hoffmanni (nec CAB.) SALV. Ibis, 1885, 429 (Camacusa, Br. Guiana).

SP. CHAR.—Similar to *F. analis* (Lafr.), but postocular region and sides of neck distinctly cinnamomeous, in marked contrast with color of hind-neck.

Adult male (coll. Salvin and Godman, Carimang River, British Guiana, December 7, 1885, H. Whitely).—Feathers of pileum blackish, broadly margined with bister brown, producing a distinctly scaled appearance; rest of upper parts bright bister brown, deeper, warmer, brown on wing coverts and secondaries, brighter on upper tail coverts. Tail warm bister brown, with exposed terminal half blackish. Postocular region (sides of occiput and terminal portion of ear coverts) and sides of neck vinaceous-brown (intermediate between Mars brown and fawn color); lores, margin of orbital region (except posteriorly) cheeks, chin, and throat, deep black, the first with a large central spot of white. Chest dull slate-gray, clanging to paler gray on sides and flanks (which are tinged with olive on outermost feathers), and lightening into pale gray on lower breast and belly, the lower portion of the latter quite white; under tail coverts clear bright tawny. Bill black; legs and feet horn brownish. Total length (skin), 6.75; wing, 3.60; tail 2.10; exposed culmen, 0.72; tarsus, 1.30; middle toe, 0.80.

*Not the description, which is entirely that of *F. saturatus* Ridgw.

Of this form I have seen but the one specimen of known locality described above. One of the alleged types of *Myothera analis* LAFR. in the museum of the Boston Society of Natural History (Lafresnaye collection, No. 5052) is apparently referable to this form, though I have not been able to compare it with Guiana specimens, having returned it before the one described above was received. The entire belly is dull white, and the breast and sides very pale brownish gray, without any olive tinge, while the under tail coverts are bright tawny. Its measurements are as follows: Wing, 3.65; tail, 2.00; exposed culmen, 0.80; tarsus, 1.35; middle toe, 0.82.

6. **Formicarius saturatus** Ridgway.

Myrmornis analis (nec *Myothera analis* LAFR.) CAB. and HEINE, Mus. Hein. II, 1859, 7 (Porto Cabello, Venezuela).

Formicarius analis SCL. P. Z. S. 1858, 277, part (Trinidad).

Formicarius crissalis (nec CAB.) SCL. Catal. 1862, 191 (Trinidad).—SALV. P. Z. S. 1866, 75, chiefly* (Trinidad).—SCL. and SALV. P. Z. S. 1867, 576, part (Trinidad); 1869, 252 (San Esteban, Venezuela).—CHAPM. Bull. Am. Mus. N. H., No. —, 1893, —. (Trinidad.)

Formicarius hoffmanni (nec CAB.) LÉOT. Ois. Trinid. 1866, 187.—FINSCH, P. Z. S. 1870, 568 (Trinidad).

HAB.—Trinidad, Venezuela, and northeastern Colombia.

SP. CHAR.—Intermediate in coloration between *F. crissalis* and *F. hoffmanni;* agreeing with the former in the darker pileum, without rusty on forehead; more restricted rusty color on side of neck, etc., and purer gray under parts, but differing in much darker coloration (especially lower parts), more intense rufescent color of sides of neck, and smaller (sometimes almost obsolete) white loral spot.

Adult male (Type No. 59315, American Museum of Natural History, Princetown, Trinidad, March 24, 1893, Frank M. Chapman).—Feathers of pileum dull black centrally, broadly margined with sepia-brown, producing a distinctly scaled appearance; rest of upper parts clear bistre brown, deepening into Vandyke brown on secondaries and brightening into burnt-umber on upper tail coverts. Lores, orbital region (bordering even the posterior margin of naked postocular space), cheeks, ear coverts (except terminal portion), chin, throat, and fore neck, deep black, the first with a small central spot of white; sides of head and neck immediately posterior to the black area, rusty brown or burnt-umber. Chest dull deep slate color; sides and flanks similar but somewhat paler, the belly still paler, though not approaching white, even on the lower portion; under tail coverts entirely clear cinnamon-rufous. Bill wholly deep black; legs and feet dark horn color. Total length (skin), 6.85; wing, 3.60; tail, 2.32; exposed culmen, 0.75; tarsus, 1.25; middle toe, 0.72.

Adult female (No. 59313, same locality and collector, March 11, 1893). —Exactly like the adult male, as described above, except that the sec-

* Description entirely.

ondaries and upper tail coverts are less rufescent, the reddish-brown color on sides of neck less intense, the sides more washed with brown, and the under tail coverts very slightly paler and duller. Total length (skin), 6.80; wing, 3.55; tail, 2.12; tarsus, 1.18; middle toe, 0.75.

This new form is based on a series of fifteen adult specimens, ten of which are from the island of Trinidad (Frank M. Chapman), one from San Esteban, Venezuela (A. Goering), one from Remedios, Colombia (T. K. Salmon), and two from unknown localities. These specimens are so uniform in their characters there can be no doubt that they represent a race easily distinguished from either *F. hoffmanni* or *F. crissalis*, though doubtless grading into both, as these almost certainly do with other forms.

The ten Trinidad specimens are so much alike that the only differences observable are exceedingly slight variations in the amount of reddish tinge to the brown of the upper parts, the size and distinctness of the white loral spot (in none is it nearly so large as in the single example of *F. crissalis* examined, its average size being about the same as in *F. hoffmanni*), and in the exact hue of the under tail coverts. As to the last-mentioned character, the variation is all but inappreciable, the extremes being what may be termed deep tawny* and chestnut-tawny. In all the specimens examined, even including those from Venezuela and Colombia and the two from unknown localities, the black of the throat has a very definite posterior outline, but is not so sharply contrasted with the color of the chest as in *F. hoffmanni*, nor is there ever any tendency of the rufescent color on the sides of the neck to form an incipient collar across the fore neck, as is often the case in *F. hoffmanni*. The black of the throat is also much more extended posteriorly, occupying the entire fore neck, than in the single specimen of *F. crissalis*, in which the fore neck is slate-gray, like the chest.

An adult male from San Esteban, Venezuela (A. Goering) and another from Remedios, Colombia (T. K. Salmon), in the collection of Messrs. Salvin and Godman, do not differ from the Trinidad specimens, except that in the former the upper parts are very slightly browner, though the exact hue is approached very closely by one or two specimens.

In the National Museum collection is a specimen from unknown locality which agrees in most respects with this form, but is still more intensely colored, the under tail coverts being rich chestnut and the upper parts a redder brown. It may be more fully described as follows:

Adult (No. 110222, U. S. Nat. Mus., H. K. Coale).—Above rich bistre brown, tinged with Vandyke, somewhat darker on top of head, and deepening on upper tail coverts into a rich burnt-umber or chestnut-brown; tail seal brown, with a broad terminal band (about 0.60 of an

*That is, a color a little more saturated than the "tawny" of my "Nomenclature of Colors" (Pl. V, Fig. 1).

inch wide on middle feathers) of brownish black; lores, orbits, anterior half of ear coverts, malar region, chin, throat, and foreneck uniform black; the first with a distinct central spot of white. Sides of occiput and neck and terminal half of ear coverts, burnt umber or brownish chestnut; under surface of body, deep brownish slate, darker and clearer on chest; under tail coverts, rich chestnut. Bill wholly deep black; legs and feet dusky horn color. Length (skin), 6.00; wing, 3.50; tail, 2.00; exposed culmen, 0.80; tarsus, 1.22; middle toe, 0.80.

One of the alleged types of *F. analis* (Lafr.) in the collection of the Boston Society of Natural History (Lafresnaye collection, No. 5053) appears, from the memoranda which I made during its inspection a year or more ago, to be referable to this form. Its measurements are as follows: Total length (mounted specimen), 6.70; wing, 3.70; tail, 2.20; exposed culmen, 0.80; tarsus, 1.22.

The other alleged type of *F. analis* (Lafresnaye collection No. 5052), on the same evidence, is *F. crissalis* (CAB.) (See p. 671.)

Compared with *F. hoffmanni* (Cab.), *F. saturatus* differs as follows: The pileum is darker and decidedly less reddish brown, without any cinnamomeous tinge on the forehead. The sides of the occiput and neck are far less distinctly cinnamomeous, being merely tinged with this color. The general color of the upper parts is very decidedly less russet, being of a nearly pure olive-brown with the rump less tinged with rusty brown, and the upper tail coverts duller rusty brown. The under parts are decidedly darker and more uniform; the whole chest and breast nearly clear slate color; the belly lighter but not approaching white; and there is much less of an olive tinge on sides and flanks; the under tail coverts are of a deeper or brighter tawny cinnamon-rufous.

7. Formicarius hoffmanni (Cabanis).

Myrmornis hoffmanni CAB. J. f. O. 1861, 95 (Costa Rica).

Formicarius hoffmanni SCL. and SALV. P. Z. S. 1864, 357 (Panama); (?) 1879, 526 (Antioquia, Colombia); Nom. Neotr. 1873, 75, part (Panama, Costa Rica?)—LAWR. Ann. Lyc. N. Y. IX, 1868, 110 (Costa Rica).—SALV. P. Z. S. 1866, 75 (Panama; Costa Rica); 1870, 195 (Bugaba, Veragua).—SCL. Cat. B. Brit. Mus., XV, 1890, 304, excl. syn. part (Panama; Veragua).—SALV. and GODM. Biol. Centr.-Am. Aves, II, pt. 30, 1892, 234, part (Las Trojas,* Costa Rica; Chiriqui, Bugaba, Lion Hill, Obispo, Paraiso Station, and Chepo, Isthmus of Panama; "Colombia").

Formicarius analis (nec *Myothera analis* LAFR.) LAWR. Ann. Lyc. N. Y. VII, 1861, 326 (Panama).

HAB.—Isthmus of Panama, Veragua, and southwestern Costa Rica.

SP. CHAR.—Similar to *F. moniliger* SCL., but paler, especially below, with the under tail coverts entirely clear rufous-tawny; without a distinct rusty collar across the fore neck, and with top of head much paler brown, becoming distinctly rusty or cinnamomeous on the forehead.

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*But not other specified Costa Rican nor Nicaraguan localities, which refer to *F. umbrosus* RIDGW.

Adult male (No. 53779, Panama, J. McLeannan)—Forehead warm brown (intermediate between Prout's brown and Vandyke brown); rest of pileum bright bister, the centers of the feathers, especially on crown, blackish; rest of upper parts bright bister, inclining to mummy brown on rump and secondaries and passing into nearly a burnt-umber hue on upper tail coverts; tail warm bister brown, the terminal third (approximately) blackish. Lores, orbits, cheeks, chin, and throat black, the first with a central spot of white; sides of hinder head and sides of neck chestnut-cinnamon or mars brown, this extending narrowly across the fore neck along the hinder edge of the black throat patch; chest and upper breast brownish gray, abruptly defined against the narrow cinnamomeous collar; sides and flanks light olive-brown, tinged with grayish; lower breast and entire belly pale dull buff, the feathers pale grayish beneath the surface; under tail coverts wholly bright rufous-tawny. Bill black; legs (in dried skin) pale brown, toes darker. Length (skin), 6.50; wing, 3.40; tail, 2.18; exposed culmen, 0.78; tarsus, 1.20; middle toe, 0.70.

Adult female (No. 53780, U. S. Nat. Mus., Panama; J. McLeannan).—Similar to the male, but rather brighter brown above, without the narrow cinnamomeous collar across fore neck (the grayish olive of the chest directly touching the black throat patch), under parts more tinged with olive, and longer under tail coverts rather darker and duller tawny-rufous. Length (skin), 6.10; wing, 3.40; tail, 2.00; exposed culmen, 0.75; tarsus, 1.25; middle toe, 0.70.

Four additional adults (not sexed) from Panama belonging to the American Museum of Natural History, New York City, and an adult male in the collection of Messrs. Salvin and Godman agree in all essential particulars with the birds described above; three of them show an indication of the cinnamomeous collar across the fore neck, but in none is it nearly so distinct as in the specimen described. An adult from Lion Hill, near Aspinwall, in the National Museum collection is likewise similar. The adult male in Messrs. Salvin and Godman's collection (Panama, McLeannan) differ slightly from the specimens described above in being a very little darker below, particularly on the belly, and in having the cinnamomeous collar across the fore neck much less distinct, though still strongly indicated.

Four specimens from southwestern Costa Rica lent me by the authorities of the Costa Rica National Museum are quite like Panama examples, though averaging a little larger. The localities represented are Trojas, near Cobagre (altitude about 3,000 feet), and Buenos Aires, all on the Pacific side.

A specimen in Messrs. Salvin and Godman's collection from Bugaba, Chiriqui (E. Arce), likewise agrees closely with Panama examples, except that the under parts are unusually dark, particularly on the chest. Another specimen from Chiriqui (precise locality not stated), in the same collection, is equally dark, though of a clearer slate-gray color

below, and the crissum is so deep a rusty hue as to be almost chestnut. In fact, this example agrees so closely with specimens of *F. saturatus* in the coloration of the under parts, throughout, that were it not for the more cinnamomeous forehead, and the locality, it might be referred to that form. Possibly it may be from the Atlantic side of Chiriqui, and if so would indicate the probability that *F. saturatus* follows the Colombian littoral on that coast to Chiriqui and there grades into *F. hoffmanni*.

Putting aside this one specimen, the remaining fourteen examples of *F. hoffmanni* can be easily distinguished from any of the fifteen specimens of *F. saturatus* by the following characters: The postocular region and sides of the neck are much more extensively and distinctly cinnamomeous; the top of the head is lighter, more reddish brown, with the forehead conspicuously rusty or cinnamomeous; the under parts are paler, less uniform, and more brownish gray; the cinnamon or rufous on the sides of the neck usually follows the posterior margin of the black throat patch, forming an incipient, or occasionally continuous though narrow, collar across the fore neck, and the under tail coverts are of a decidedly lighter rufous-tawny.

8. Formicarius umbrosus Ridgway.

Formicarius hoffmanni (nec *Myrmornis hoffmanni* CAB.) BOUC. P. Z. S. 1878, 62 (San Carlos, Costa Rica).—ZELED. Proc. U. S. Nat. Mus. VIII, 1885, 108 (Costa Rica); An. Mus. Nac. C. R. 1887, 115 (Costa Rica).—SALV. and GODM. Biol. Centr. Am., Aves. II, pt. 30, 1892, 234, part (Los Sábalos, Nicaragua; San Carlos, Jimenez, and Pacuare, Costa Rica).

Formicarius hoffmani NUTTING, Proc. U. S. Nat. Mus., VI, 1883, 405 (Los Sábalos, Nicaragua).

HAB.—Atlantic slope of Costa Rica and Nicaragua.

SP. CHAR.—Similar to *F. hoffmanni* (CAB.), but colors more intense throughout, the under tail coverts dull rusty brown, with longer feathers chiefly dusky; rusty coloring on sides of neck darker and more restricted, and forehead same color as crown.

Adult male (type, No. 68243, Talamanca, Costa Rica, J. Cooper).—Pileum rich bister brown, with centers of the feathers blackish, producing an indistinctly scaled appearance, these dusky centers more concealed on the forehead; rest of upper parts rich mummy brown, brightening into burnt-umber or almost chestnut on upper tail coverts. Lores, margin of bare orbital space, cheeks, chin, and throat black; post-ocular region, terminal portion of auricular region, and sides of neck rusty brown or light burnt-umber. Chest, sides, and flanks dull grayish brown (the sides washed with bister), lightening on breast and belly into dull brownish gray or hair brown. Shorter under tail coverts bright russet, the longer feathers blackish, margined and tipped with light mummy brown. Bill black; "iris chocolate;" legs and feet horn brown. Total length (skin), 6.50; wing, 3.42; tail, 2.15; exposed culmen, 0.77; tarsus, 1.35; middle toe, 0.72.

Adult female (No. 68245, same locality and collector).—Similar to the adult male, as described above, but upper parts less reddish brown (nearer "bister" than "mummy," the upper tail coverts bright mummy brown instead of chestnut-umber); chest and sides brownish slate-gray, the latter washed with olive-brown; middle line of breast and belly, also the anal region, dirty whitish. Total length (skin), 6.30: wing, 3.40; tail, 2.10; exposed culmen, 0.72; tarsus, 1.23; middle toe, 0.70.

Young female (No. 8108, Museo Nacional de Costa Rica, Jimenez, Costa Rica, July 11, 1892, A. H. Verrill).—Similar in general coloration to the adult female, but whole pileum uniform brownish black with tips of feathers more brown, chin and throat buff spotted with dull black, chest sooty blackish, feathers of belly tipped with brownish gray (producing an indistinct spotted or clouded appearance), and longer under tail coverts uniform black. Basal two-thirds of lower mandible light colored (dull yellowish in dried skin).

The nineteen adult specimens of this form show the same amount of individual variations as other forms. This variation affects chiefly the exact hue of the brown color of the upper parts (which ranges from rich mummy brown to clear bistre on the back and rich burnt-umber, almost chestnut, to mummy brown on the upper tail coverts, the average hue being intermediate) and the relative amount of brown and gray on the under parts. The adult male described above has the under parts more brown than any others in the entire series. The opposite extreme is represented by No. 91264, U. S. National Museum, from Los Sàbalos, Nicaragua (adult male, May 17, 1883, C. C. Nutting), and No. 7170, Costa Rica National Museum, Reventazon, Costa Rica (adult male, February 21, 1892, N. Carranza), in which the under parts are a nearly uniform deep smoky slate color, darker on the chest, paler on the belly, only the sides and flanks being distinctly tinged with olive. In a few specimens (as No. 128349, adult male, Escondido River, Nicaragua, September 6, 1892, C. W. Richmond) the belly is quite extensively light colored—pale buffy grayish, sometimes inclining to soiled white toward the anal region. In the coloration of the under tail coverts there is practically no variation, the longer or more posterior feathers being always blackish, merely margined with rusty brown, only the shorter or more anterior feathers being uniform rusty, and this not nearly so light and tawny a hue as on the same feathers of *F. hoffmanni*. In none of the nineteen specimens does the rusty color of the sides of the neck show a tendency to extend across the fore neck, forming an incipient or occasionally distinct though narrow collar, as frequently occurs in *F. hoffmanni;* and, while the black of the throat always has a definite posterior outline, the color of the chest is sometimes so dark that the contrast is by no means conspicuous.

From *F. moniliger* this form may be readily distinguished by the entire absence of the rusty band across the fore neck and the more rusty shorter under tail coverts.

9. Formicarius moniliger Sclater.

Formicarius moniliger SCL., P. Z. S. 1856, 294 (Cordova, Vera Cruz, Mexico); 1857, 47; 1858, 278 (Vera Cruz; Mosquito coast); 1859, 383 (Playa Vicente, Oaxaca); Catal. 1862, 191, No. 1165 (Oaxaca); Cat. B. Brit. Mus. XV, 1890, 303, part (s. Mexico; Guatemala; Belize, Brit. Honduras).—SALV., Ibis, 1861, 353 (Chisec, centr. Guatemala); P. Z. S. 1866, 75 (Mexico and Guatemala).—SUMICH., Mem. Bost. Soc. N. H. i, 1869, 556 (near Protrero, Vera Cruz); La. Nat. v, ——, 248 (do).—SCL. and SALV., Nom. Neotr. 1873, 75 (Mexico and Guatemala).—SALV. and GODM., Biol. Centr.-Am., Aves, II, pt. 30, 1892, 233, part (Cordova, Cerro de la Defensa, near Protrero, Atoyac, and Playa Vicente, s. Mexico; Cayo, Brit. Honduras; Vera Paz, Chisec, Kampamac, Choctum, and Tactic, Guatemala).

Myrmornis moniligera CAB., J. f. O. 1861, 96.

HAB.—Southern Mexico, Guatemala, and British Honduras.

SP. CHAR.—Above brown, more russet on upper tail coverts; chin, throat, cheeks, orbits, and lores black, the latter with a white spot; sides of neck and band across fore neck, immediately below black throat, dull cinnamon-chestnut; rest of under parts dull brownish gray, darker on chest, paler on belly; under tail coverts dusky, more or less tipped with light brown, this nearly uniform over shorter anterior feathers.

Adult male (No. 22367, "Mexique," Verreaux).—Pileum deep warm bistre, the feathers darker centrally; hind neck Vandyke brown; rest of upper parts rich brown (intermediate between mummy brown and bistre), brightening into burnt-umber on upper tail coverts. Lores, orbits, malar region, chin, and throat uniform dull black, the first with a distinct central spot of white; immediately behind this black area is a broad band of chestnut, beginning on the ear coverts, passing over the sides of the neck, and thence across the fore neck; chest dark olive-grayish; sides and flanks olive-brown or light bistre; breast and sides of abdomen brownish gray, considerably paler than chest, the feathers of the median portion of the abdomen margined at tips with buffy whitish, which predominates posteriorly; under tail coverts dusky, tipped with light fulvous-brown, this amounting to a mere terminal edging on the longer posterior feathers, but prevailing on the shorter anterior ones. Bill black, the lower mandible more brownish; legs and feet light brown (in dried skin). Length (skin), 6.80; wings, 3.45; tail, 2.00; exposed culmen, 0.80; tarsus, 1.25; middle toe, 0.75.

Adult female (Coll. Salvin and Godman, Atoyac, Vera Cruz, Mexico, April, D. W. S.).—Similar to adult male as described above, but darker, especially below, where the entire surface posterior to the rusty collar (except under tail coverts) is dark sooty gray, darkest on the chest and palest on the lower belly. The rusty collar across the fore neck much narrower (only about 0.10 to 0.15 of an inch), and the white loral spot smaller. Total length (skin), 6.35; wing, 3.55; tail, 2.15; exposed culmen, 0.80; tarsus, 1.23; middle toe, 0.80.

Juv. (No. 43531, Am. Mus. Nat. Hist., Guatemala: Lawrence collection).—Upper parts colored as in the adult, lower parts also as in the

adult, except the throat, which has the black replaced by dull brownish dusky (almost exactly like color of chest), the feathers of the posterior portion tipped with rusty, forming a narrow, somewhat broken, band, much less distinct than in the adult. Upper mandible black, tipped with yellowish white; lower, brown, with yellowish-white tip.

With two specimens from Mexico, four from Guatemala, and one from British Honduras, I am unable to appreciate any constant differences of coloration according to locality, except in the case of the last-mentioned example, which is lighter colored (extensively buffy-whitish) on the middle line of the breast and belly, with the upper parts of an appreciably lighter or clearer tawny-bistre. The darker specimens from Guatemala are quite as dark as the Vera Cruz specimen described above, but all the Guatemala examples are perhaps a little bit brighter in the color of their upper parts than those from Mexico, though the difference is so very slight that I strongly doubt its constancy in a large series. Certainly there are no variations of color in this series which even approximate the paleness of coloration which strongly characterizes Mr. Lawrence's *F. pallidus*, from Yucatan.

10. **Formicarius pallidus** Lawrence.

Furnarius (lapsus pennæ) *pallidus* Lawr., Ann. N. Y. Acad. Sci., II, No. 9, May 29, 1882, 288 (Yucatan).

Formicarius pallidus Lawr., Ann. N. Y. Acad. Sci. II, No. 9, 1882.

Formicarius moniliger Scl., Cat. B. Brit. Mus., XV, 1890; 303, part.—Salv. and Godm., Biol. Centr.-Am., Aves, II, pt. 30, 1892, 233, part.

Hab.—Yucatan.

Sp. Char.—Similar to *F. moniliger* Scl., but very much paler throughout.

Adult (Type, No. 43543, American Museum of Natural History, Yucatan, G. F. Gaumer).—Above, plain light grayish brown,* deepening on lower rump and upper tail coverts into a more tawny-olive or russet hue; tail rather light olive-brown, with inner webs and terminal portion of outer webs dusky. Chin, upper and middle portions of throat, and thence upward to and surrounding orbits, dull black; lores also black, but marked with a central spot of white about 0.15 of an inch long. Sides of head and neck immediately behind the black area deep cinnamon-rufous, continued in a band across lower throat; chest, sides, and flanks rather deep brownish gray, fading into dull white on the belly; under tail coverts light wood-brown, with indistinct paler shaft streaks, the longer feathers less buffy. Bill black; legs and feet horn-color. Length (skin), 6.80; wing, 3.65; tail, 2.25; exposed culmen, 0.85; tarsus, 1.25; middle toe, 0.80.

Another adult in the collection of Messrs. Salvin and Godman (Tizimin, Yucatan, G. F. Gaumer) agrees closely with the type, but is very slightly deeper olivaceous above, and the rusty collar across the fore

* Intermediate between olive and hair-brown, with a slight tinge of Isabella color.

neck is a duller, more cinnamomeous, hue. It does not, however, approach in intensity of coloration even the palest and dullest colored specimens of *F. moniliger* from Guatemala, Honduras, and other parts of the latter's range. Its measurements are as follows: Length, (stretched skin), about 8.00; wing, 3.55; tail, 2.23; exposed culmen, 0.82; tarsus, 1.20; middle toe, 0.80.

While there can be no doubt that this form is merely a pallid local race of *F. moniliger*, and should therefore be known as *Formicarius moniliger pallidus*, we have not yet the proof of such fact; and, in order to preserve uniformity of nomenclature in this paper, I have given it a binomial appellation, as I have done with forms which undoubtedly are conspecific with *F. analis*.

11. Formicarius rufipectus Salvin.

Formicarius rufipectus SALV., P. Z. S., 1866, 73, 74, pl. VIII (Veragua); 1867, 145 (do.).—SCL. and SALV., Nom. Neotr., 1873, 75 (Veragua).—SCL., Cat. B. Brit. Mus., XV, 1890, 306 (Veragua; Baisa, Ecuador?).—SALV. and GODM.. Biol. Centr.-Am., Aves, II, pt. 30, 1892, 235 (Santiago de Veragua; Baisa, Ecuador?).

? *Formicarius thoracicus* "STOLZM. MS.," TACZAN. and BERL., P. Z. S., 1885, 101 (Machay, e. Ecuador).

HAB.—Veragua; eastern Ecuador?

SP. CHAR.—Above brownish black, the rump dusky rufous, the pileum tinged with rufous; lores and throat black; breast, crissum, and middle of the belly chestnut-rufous; sides of the body sooty; bill black; feet brown.

Total length, 7 inches; wing, 3.40; tail, 2.25; tarsi, 1.50; bill to the rictus, 1.10.

Similar to *F. analis* (D'ORB. and LAFR.), but at first sight distinguished by the chestnut-rufous breast. [Translation of the original description.]

According to Messrs. Salvin and Godman (Biol. Centr.-Am., Aves, II, pt. 30, pp. 235, 236), "this well-marked species comes next to *F. analis* [*i. e., F. nigricapillus* Cherrie] in many of its characters, such as the absence of the white spot on the lores and the wholly black ear coverts. Its rufous breast, however, renders it readily distinguishable as well from *F. analis* as from all its congeners."

Never having seen a specimen of this very distinct species, I am unable to give a more detailed description of it.

(12?) Formicarius thoracicus Taczanowski and von Berlepsch.

Formicarius thoracicus "STOLZM. MS." TACZAN. and BERL., P. Z. S., 1885, 101 (Machay, e. Ecuador).—SCL., Cat. B. Brit. Mus., XV, 1890, 301 footnote.—SALV. and GODM., Biol. Centr.-Am., Aves, II, pt. 30, 1890, 236, sub *F. rufipectus*.

HAB.—Eastern Ecuador (Machay, altitude 5,000 feet).

SP. CHAR.—Above dusky olive-brown; entire head, with throat, black; breast dark rufous; abdomen olive-brown; under tail coverts rufous; wings blackish, the upper coverts and the outer webs of the

remiges the some color as the back; the under wing coverts varied with ochraceous and black; tail black.

Adult male.—The black occupies the whole of the head, including the throat; the upper parts are brownish olive, much darker on the rump, and changing into rusty on the upper tail coverts; fore neck and breast very dark rust-red; abdomen sooty olive, much lighter than the back; under tail coverts dark rusty. Wings blackish, the upper coverts and outer webs of the remiges the same color as the back, the under wing coverts bright ochraceous with two large black cross-bands, the inner webs of the remiges russet at the base. Tail blackish. Bill horn-black; feet deep brownish gray; iris deep brown.

Female.—Resembles the male in all particulars, and is only distinguished by the less intense rusty on the breast, extended to the middle of the abdomen and continued as a wide stripe of russet-ocher to the under tail coverts.

Male.—Length of wing 89, tail 59, bill 27, tarsus 39 millimeters.

Female.—Total length 218, spread of wing 310, wing 89, tail 60, bill 27, tarsus 38 millimeters.

The above is a free translation of the original description, cited above.

Although Messrs. Salvin and Godman (*l. c.*) consider this bird as being probably the same as *F. thoracicus* Salv., there are features in the description which seem to indicate its distinctness. For example, the following points of disagreement in the descriptions may be cited:

	F. rufipectus.	*F. thoracicus.*
Upper parts	Brownish black	Dusky olive-brown.
Top of head and hind neck	Brownish black, tipped with rufous	Black.

It may be, however, that the two birds are really the same species, and that their apparent differences may disappear in a larger series; but until such is proven to be the case I prefer to keep them separate.

DESCRIPTION OF A NEW STORM PETREL FROM THE COAST OF WESTERN MEXICO.

BY

ROBERT RIDGWAY,

Curator of the Department of Birds.

The type-specimen herein described was collected by John Xantus nearly thirty-five years ago, but Mr. Chas. H. Townsend's considerable series of excellently prepared specimens—the only others taken, to my knowledge—entitle him to the credit of having established the specific characters of this species, to which I consequently take pleasure in giving his name.

Oceanodroma townsendi, sp. nov.

Thalassidroma melania "BONAP." BAIRD, Proc. Ac. Nat. Sci. Philad. 1859, 301, 306 (Cape St. Lucas).

Cymochorea melania COUES, Proc. Ac. Nat. Sci. Philad. 1864, 76; Key, 1872, 329; Check List, 1873, No. 589.—B. B. & R., Water B. N. Am. II, 1884, 411.

Cymochorea melæna RIDGW., Nom. N. Am. B. 1881, No. 724.—COUES, Check List, 2d ed. 1882, No. 824; Key, 2d ed. 1884, 781.

Oceanodroma melania A. O. U., Check List, 1886, No. 107.—RIDGW., Man. N. Am. B. 1887, 70.

Oceanodroma townsendi RIDGW., MS.

SP. CHAR.—Tarsus decidedly longer than middle toe, with claw. Color, sooty brownish or dusky, darker above; under wing coverts entirely uniform in color with lower parts; exposed surface of greater wing coverts entirely light grayish brown. Total length (skins), about 8.00–8.50 inches (average, 8.20); wing, 6.60–7.00 (6.78); tail, 3.30–3.60 (3.43); depth of fork, 0.95–1.30 (1.15); exposed culmen, 0.57–0.62 (0.59); length of nasal tubes, 0.22–0.30 (0.27); tarsus, 1.20–1.28 (1.24); middle toe, with claw, 1.10–1.20 (1.13).

HAB.—Off coast of western Mexico, north to Cape St. Lucas and Guaymas.

Type, No. 13025, U. S. National Museum, ♂ ad., Cape St. Lucas, Lower California; J. Xantus.

OBSERVATIONS.—A series of nine finely-prepared skins of this spe, cies. collected by Mr. C. H. Townsend off Guaymas and Acapulco-Mexico, proves conclusively that this bird can not be the *Thalassidroma melania* of Bonaparte, neither the dimensions nor the coloration

agreeing at all closely with the latter, as the following comparison will show:

Measurements.

	Wing.	Tail.	Fork of tail.	Exposed culmen.	Tarsus.	Middle toe, with claw.
O. townsendi	7.00 (6.78)	3.30 (3.43)	1.22 (1.15)	0.62 (0.59)	1.22 (1.24)	1.20 (1.2[illegible]
O. melania	7.83	3.30	1.22	0.82	1.22	1.30

Coloration.

O. townsendi.—Above dark sooty brown, black only on tertials, secondaries, primaries, primary coverts, and tail; beneath sooty grayish brown.

O. melania.—Above raven black ("nigro coracina"); beneath sooty.

In the measurements of *O. townsendi* given above, the first under each heading represents the nearest approach, in a series of ten specimens, to the corresponding measurement of *O. melania*, the number immediately following (in parentheses) being the average of these ten specimens. It will be observed that while the length of the tail, the depth of its fork, and the length of the tarsus are the same in the two species, the wing, the exposed culmen, and the middle toe are very much longer in *O. melania* than in *O. townsendi*. The measurements of *O. melania* were taken from the type by Pucheran, for Prof. Baird, in millimeters, and have been carefully reduced to inches and hundredths.

DESCRIPTION OF A NEW SPECIES OF MOUSE (SITOMYS DECOLORUS) FROM CENTRAL AMERICA.

By
FREDERICK W. TRUE,
Curator of the Department of Mammals.

Among some specimens of mammals recently collected by Mr. E. Wittkugel in Honduras for the National Museum, is a species of *Sitomys*, belonging to the subgenus *Rhipidomys* (=*Nyctomys* Saussure), which appears to be undescribed. Dr. J. A. Allen has already made mention of a specimen of this species,* which specimen he regarded as the young of *S. sumichrasti*. He has kindly sent it to me for examination. It is an imperfect skin of a youngish individual, collected at Santo Domingo, Tehuantepec, Mexico, by Dr. A. C. Buller. The tail is wanting. It appears to agree in every respect with the Honduras specimen in the National Museum, from which the following description is taken. I may say incidentally that we have in the museum the skin of a young *S. sumichrasti*, which shows the closest possible similarity to the adults of that species.

The following is a description of Wittkugel's Honduras specimen, No. 21092, from Rio de las Piedras, collected Dec. 11, 1890:

Sitomys (Rhipidomys) decolorus, sp. nov.

Size intermediate between *Mus musculus* and *M. decumanus*. Ears prominent, thin, nearly naked. Soles naked, except in the proximal fourth, the naked portion not granular, and with prominent pads. Tail clothed with longish hairs, growing more abundant toward its tip, where they conceal the scales and form a pencil.

Color above brownish-isabelline, more or less shaded with gray along the middle of the back. Flanks clearer. Under surfaces and lower part of cheeks pure white, not blending with the color of the sides. Feet like the back, but the hinder ones somewhat more dusky. Toes impure white. Ears sparsely clothed with rather long, chocolate-brown hairs externally, and similar, but somewhat lighter-colored, hairs internally. Hairs of the tail chocolate-brown, not lighter

* Bull. Amer. Mus. Nat. Hist., III, 1890, 187.

Proceedings National Museum Vol. XVI—No. 963.

below than above. Whiskers black. Eye surrounded by a dark-brown ring.

*Dimensions of the body.**

Measurements.	21092. ♀ ad. Rio de las Piedras. Honduras.	3104 ♀ jvs Santo Domingo. Mexico.[a]
	mm.	mm.
Length of head and body	108.0	104.0
Length of tail-vertebræ	85.0	....
Length of terminal pencil of tail	10.0	....
Length of hind foot and claw	23.0	22.0
Height of ear from lower margin of orifice	14.0	13.5

a American Museum of Natural History.

The skull has strong supraorbital ridges, but presents no well-defined differences from that of *S. sumichrasti*.

This species is easily distinguished from *S. sumichrasti*, of which there are two specimens in the National collection—one, as already stated, a young individual, and the other an adult from Mirador, Mexico, collected by Dr. Sartorius. The latter was compared with the type-specimen of *S. sumichrasti* from the Geneva Museum, in 1890, by Dr. J. A. Allen, Dr. Merriam, and myself, and found to be identical.

From *S. sumichrasti*, the species herein described differs by its much paler and yellower coloration, its dusky ears and tail, and also by the comparative shortness of the tail.

I am unable to find any described species to which it can be considered as belonging. From the fact that one specimen comes from Mexico and the other from Honduras it would appear that it has a wide distribution in Central America.

I would remark in this connection that it seems probable to me that *S. salvini* (Tomes) is distinct from *S. sumichrasti*, although the two are united by Alston and Trouessart. Specimens of *S. salvini* from Guatemala and Honduras in the National collection agree with each other and differ from *S. surmichrasti*, from Mexico, in having a chocolate-brown tail and large, thin ears, clothed with hairs of the same color. The tarsus is also more or less dusky, and the ferruginous of the back is shaded with black by the intermingling of hairs of that color.

In *S. sumichrasti* the upper surfaces, together with the tail, ears, and tarsi, are nearly uniform dull ferruginous throughout.

*From the dry skin.

DESCRIPTION OF A NEW GEOTHLYPIS FROM BROWNSVILLE, TEXAS.

BY

ROBERT RIDGWAY,

Curator of the Department of Birds.

In The Auk for July, 1891 (p. 316), Dr. J. A. Allen records the capture of a bird at Brownsville, Tex., which he identified as *Geothlypis poliocephala palpebralis* (Ridgw.), and he also mentions a specimen in Mr. Sennett's collection taken at Aldema, Tamaulipas, on the Mexican side of the Rio Grande. I have not had an opportunity to compare the specimens referred to with the type of *G. palpebralis;* but the National Museum has recently received from Dr. Wm. L. Ralph five adult males and one adult female of a form of the *G. poliocephala* group, collected at Brownsville in April and May, 1893, and therefore presumably identical with the specimens mentioned by Dr. Allen.

It requires but a glance, however, to show that these specimens are not *G. palpebralis*, which is entirely yellow beneath, while all the Brownsville birds have the sides, flanks and anal region—some of them much the greater portion of the under surface of the body—pale dull buffy, in marked contrast with the clear yellow color of the throat, etc. In this respect they do, however, agree very closely with the type of *G. poliocephala* Baird (from Mazatlan, Mexico), and, were it not for certain constant differences of coloration and proportions, might be considered the same. Since these constant differences do exist, it becomes necessary for me to recognize the Brownsville birds as representing a local or geographical form, which may be characterized as follows:

Geothlypis poliocephala ralphi, subsp. nov.

Geothlypis poliocephala palpebralis (RIDGW.) ALLEN, Auk, July, 1891, 316 (nec *Geothlypis palpebralis* RIDGW.).—A. O. U. Check List (Fourth Suppl., 1892), No. 682.1.

SUBSP. CHAR.—Similar to *G. poliocephala* Baird, but larger (the bill especially), upper parts grayer (the tail particularly), and the edge of the wing and under tail coverts much paler yellow.

HAB.—Lower Rio Grande Valley.

Type, No. 129348, ♂ ad., Brownsville, Texas, May 4, 1893. Presented by Dr. Wm. L. Ralph.

THE PROPER GENERIC NAME OF THE TUNNIES.

BY
THEODORE GILL, M. D., PH. D.

It must be conceded that neither of the names generally used till lately for the tunnies can be retained. What is the proper substitute has been a question in dispute.

President Jordan has proposed a new name (*Albacora*) for the true tunny and another (*Germo*) for the long-finned albacore, but referring both as subgenera to a common genus for which he took the name *Albacora*.*

The present writer has accepted the name *Orycnus*, originally the result of a *lapsus calami*,† but subsequently deliberately adopted for the short-finned tunnies.‡

The reasons given for the revival of the name of *Orycnus* have not satisfied President Jordan or his disciples, Dresslar and Fesler. The latter have commented on the subject as follows:

> The name *Orycnus* Cooper, it seems to us, is preoccupied by its previous use for another genus or subgenus by Gill. It is therefore ineligible. In other words, a generic name originating in a misprint of a well-knowr name can not be later used as a name of another genus.§

Orycnus was not taken by Cooper for another genus or subgenus than that for which it was originally used by Gill. That author, under the caption "*Genus Orycnus* Cuv.," specified "*Orycnus secundidorsalis*," the tunny, and that only. For the tunnies only Cooper retained the name, restricting *Orcynus* to the long-finned Albacores. It seems to me that the course was legitimate. However, a discovery which I made soon after the publication of my paper "On the proper generic name of the tunny and albacore" will settle the question against all of us in accordance with the principles of nomenclature recognized by us.

In 1845 the twenty-fifth volume of the Encyclopædia Metropolitana was published, and in it are zoölogical articles by Dr. J. F. South.

*Jordan (D. S.) A Manual of the Vertebrate Animals of the Northern United States. Fifth edition. Chicago, 1888 (p. 106).

†Proceedings of the U. S. National Museum, Vol. XI, p. 319, 1888.

‡Proceedings of the California Academy of Natural Sciences, Vol. III, p. 77, 1863.

§Bulletin of the U. S. Fish Commission, Vol. VII, for 1887 (p. 437). Washington.

Among them is one on "*Thunnus*." After the "generic character" and some comments, a paragraph was devoted to the nomenclature in the following terms:

> Cuvier has applied the word *Thynnus* generically to these fish, but as it had been long before used by Fabricius as the title of a genus of hymenopterous insects, it will be better to use the corresponding word *Thunnus* to prevent confusion.

The name *Thunnus* was thus suggested and used as a substitute for *Thynnus* and as sufficiently distinct from the latter; it has classical sanction, the form *Thunnus* being the regular one and preferred by many scholars* to *Thynnus*.† *Thunnus*, it is true, is a mere variant of *Thynnus*, but, being a variant, it is different and, as different, was formally introduced as a substitute for *Thynnus*. By most American ichthyologists it will therefore be accepted.

The essential synonymy of *Thunnus* is as follows:

THUNNUS.

Synonymy.

× Thynnus *Cuvier*, Règne Animal [1re éd.], t. 2, p. 313, 1817. (*T. thynnus*. Not *Thynnus* of Fab., 1775.)
> Orcynus *Cuvier*, Règne Animal [1re éd.], t. 2, p. 314, 1817. (*T. alalonga*. Not *Orcynus* of Raf., 1815.)
< Thynnus *Cuv. & Val.*, Hist. Nat. de Poissons, t. 8, p. 57, 1831.
< Thunnus *South*, Enc. Metrop., v. 25, p. 620, 1845.
< Thynnus *Günther*, Cat. Fishes in Brit. Mus., v. 2, p. 362, 1860.
< Orycnus *Gill*, Cat. Fishes E. Coast N. America, p. 35, 1861; Proc. Acad. Nat. Sci. Phila., [v. 14], p. 125, 1862. (*Lapsus calami.*)
< Orcynus *Gill*, Proc. Acad. Nat. Sci. Phila., [v. 14], p. 329, 1862.
× Orycnus *Cooper*, Proc. Cal. Acad. Nat. Sci., v. 3, p. 77, 1863.
> Orcynus *Cooper*, Proc. Cal. Acad. Nat. Sci., v. 3, p. 77, 1863.
= Albacora *Jordan*, Man. Vert. An. N. U. S., 5th ed., p. 106, 1888. (*T. thynnus*.)
> Germo *Jordan*, Proc. Acad. Nat. Sci. Phila., 1888. (*T. alalonga*.)
Scomber sp. *Linn.* et vet. auct.

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* "Thunnus (also written thynnus), i, *m*, θύννος, the *tunny* or *tunny-fish*, Scomber Thynnus, Linn.; Plin. 9, 15, 17, § 44, sq.; Hor. S. 2, 5, 44; Ov. Hal. 98; Mart. 10. 48. 12;" Andrews' Copious and Critical Latin English Lexicon.

† "Thynnus, i. v. [*i. e.* vide] thunnus." Andrews *op. cit.*

THE SHELL HEAPS OF THE EAST COAST OF FLORIDA.

BY
DeWitt Webb, M. D.

(With Plates LXXVIII–LXXXIV.)

There are many evidences that a portion of the east coast of Florida was quite thickly settled in prehistoric times, and remains of this settlement are found in refuse heaps of villages and single habitations. These heaps are from a few square yards to many acres in extent, and from 1 to 15 feet in depth. They must have been the abode of a race for many generations. The remains indicate that the variety of food obtained was great, and included all kinds of shellfish, from the large *Busycon perversum* to the tiny *Donax*, numerous kinds of fish and a species of turtle, together with various birds and mammals which now inhabit the peninsula. The skull of a whale has also been found. In connection with these remains are found the various members of the human skeleton in positions which would at least suggest cannibalism. There are hearths with accumulations of ashes and shells mingled with pottery (mostly in fragments) and implements and weapons of shell. These implements and weapons tell us all we know of the mode of life of the race which inhabited the region, and enable us more or less correctly to reconstruct this early society. That the people were hunters and fishers, the variety of animals, birds, and fish which went to supply their larders abundantly testifies. The porpoise seems to have been a favorite article of food, while the remains of the manatee are found in the shell heaps farther north than the present habitat of the animal. The whale, whose remains were found beneath one of the large heaps, at least a quarter of a mile from the ocean, may have been stranded on the beach; but all the other fish, birds, and animals were doubtless captured by the wary and active savage. It would seem as if many of the fish might have been taken with some sort of a net, as they must have employed a twisted cord for many purposes. There are marks on much of the pottery showing it to have been molded in baskets made of cord. Sinkers of various shapes were used.

The implements of shell were, for the most part, constructed from the *Busycon carica*, and the St. Augustine collection shows all forms and

stages of this construction. While the use to which the greater number of the implements of shell must have been put is obvious, there is much uncertainty regarding others which are found in abundance. One of these, known as the perforated shell, may have been used for the dressing of skins, and the perforation which has provoked so much speculation, made for the insertion of the finger to give more firmness to the grasp.* (Pl. LXXVIII.)

Another, found in abundance, is made usually from the smaller shells of the Strombus, and is worked as near as possible to the form of a ball. They may have been playthings of the children. The drinking shells were prepared with great care, and seem also to have been used as cooking utensils, some of them showing marks of exposure to fire. (Pl. LXXIX.) From the great number of perforated shells found on one small heap I was led to conclude that it was in some sense a manufactory of these articles. Some of these scrapers or gouges show as sharp an edge as it is possible for a shell to receive, while others are dull. Other utensils take the form of spoons. A granite or other pebble with an end flattened and polished was probably used to put an edge on such implements as required to be sharpened.

The pottery, though mostly in fragments, affords an interesting study and shows great variety of design in its ornamentation. Some of the vessels were made in baskets woven from cord, while others, from the peculiar marking on their external surface, must have been made in another way. The great smoothness and perfect regularity of the internal surface of these vessels is remarkable. They vary much as to the character of the material of which they are made. Some are of pure clay; and of these, some are thoroughly baked and hardened, while others are slightly baked and therefore brittle. Others have an admixture, to a greater or less degree, of sand, and are harder. In size they vary from a bowl holding 1 or 2 quarts to vessels holding 5 gallons, and in shape from a shallow pan-like dish to a pot or vessel resembling a jug. (Pls. LXXX, LXXXI.) The ornamentation includes about one hundred different designs, the principal of which are shown in Pl. LXXXII. It is easy to understand the origin of the fine cord-like markings which appear on the surface of those vessels which were molded in baskets. Other vessels were apparently ornamented by using a pen-like instrument made from a reed, while the clay was soft, and still others by rolling portions of the soft clay and then putting them on as a housewife sometimes ornaments her pie crusts. In one specimen, the impress of the fingers is plainly visible, showing even the texture of the skin. By far the larger portion, however, appear to have been ornamented by the use of a stamp, which left the surface arranged in squares, as shown in the plate. Fully three-fourths of the pottery found is ornamented in this

*These shells have been found with wooden handles inserted in the perforation for use as hatchets or picks, and the U. S. National Museum possesses several specimens.—T. W.

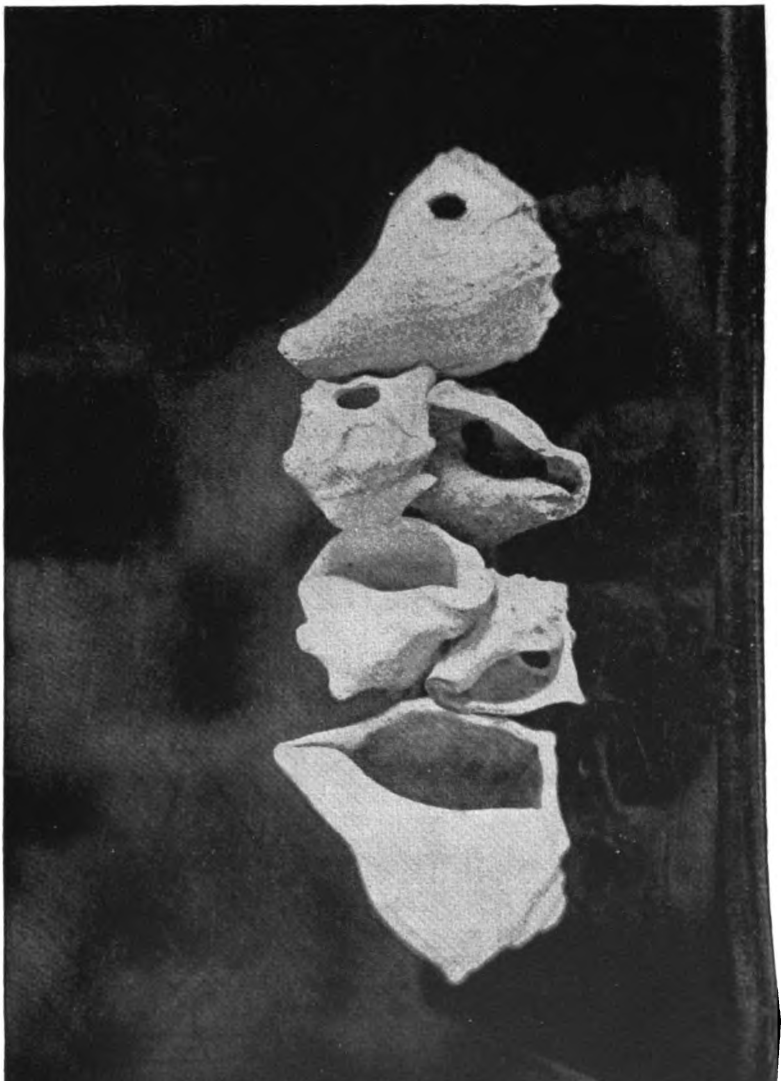
way. These vessels must have served for cooking, as well as for holding water, as many are blackened from exposure to the fire. While it is probable that these people cooked the greater part of their food by roasting over the fire, yet the tiny *Donax* shells at least, which are present in immense numbers, must have been boiled in water to obtain a broth. They are too small to have been cooked in any other way. The number and extent of the hearths and the amount of ashes proves that the Indigenes usually cooked their food.

The form of the mounds and collections of shells is of interest, and some of the larger ones may enable us to determine the form of the prehistoric habitation. When individual families dwelt by themselves there would be one slowly growing heap for each, which after a time might be abandoned. When a comparatively wide extent was occupied the remains would take the form of what we now call Shell Fields—places where the ground for many acres appears to be full of shells, but without elevations rising above the general level. A form common among the heaps is that of a long bank or mound, from 2 to 10 or more feet in thickness, and covering from one to several acres, always near the water and usually in proximity to an inlet of the sea. Scattered through these heaps, from the surface of the soil beneath to their summits, are found implements, utensils, and fragments, of pottery. A hearth, with a foot or more of ashes and 6 feet or even more across, may be found, with 5 or 6 feet of shells above it. This disposition of remains gives a clew to the manner of formation of the mounds and is well shown in the large mound below Matanzas Inlet, which covers more than 30 acres (Pl. LXXXIV). The side facing the ocean is from 10 to 12 feet in depth, but has suffered from the encroachment of the sea to an extent which can not be determined (Pl. LXXXIII). The highest part of the mound covers about 2 acres, and back of this, extending to the Matanzas River, lies the remainder, disposed in circles of greater or less extent and covered with forest. These circles adjoin each other over a large part of the territory. They are from 4 to 8 feet in depth and from 12 to 15 feet across at the bottom. This was a dwelling place, and the daily refuse was thrown out on all sides, and so the circles of shells, bones, etc., gradually grew higher and higher, surrounding the rude dwelling like a wall. This wall would also serve for protection from the winds of winter and likewise as a pit for defense in case of attack. When this hollow had become too deep, or the wall about it too high, it would be abandoned, and the owner, pitching his tent on the top of surrounding ridges, would use the hollow as a pit in which to throw refuse.

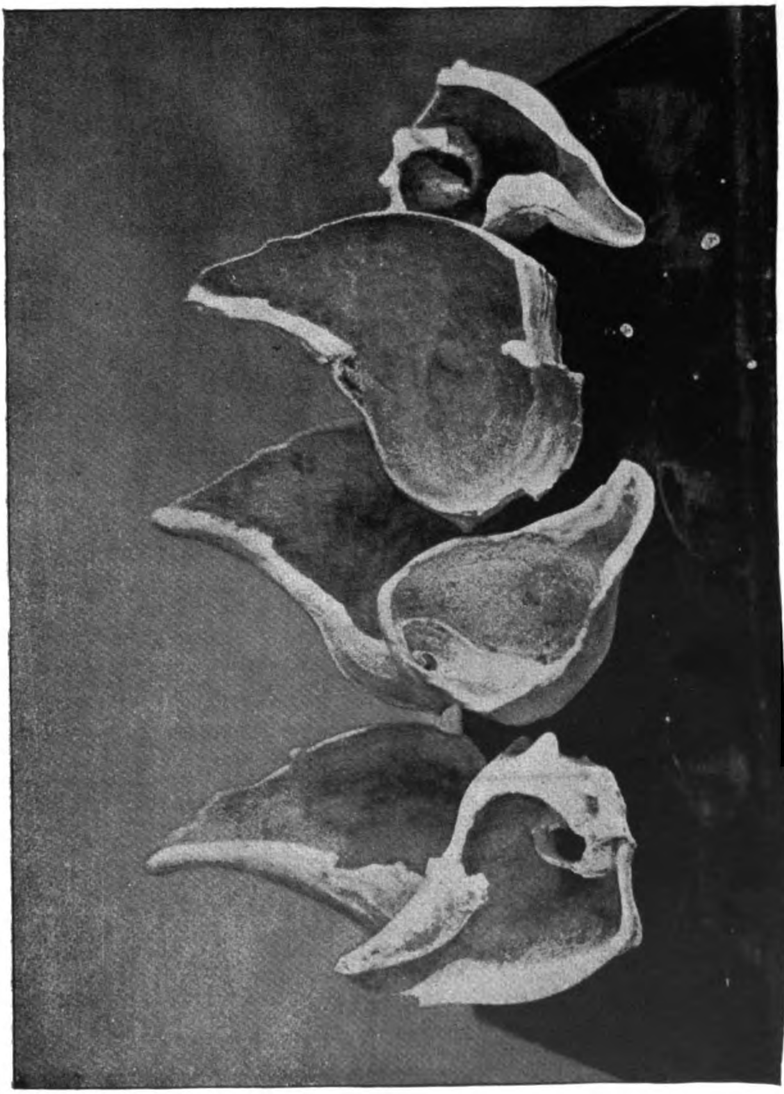
The mound of which I am now speaking would appear to have been in some sort a center of population for many miles around. A spring of water lies in the midst of it, and the waterway was kept open to the river. Smaller mounds are found scattered up and down the river for several miles in the vicinity. One of these, some 2 miles north and

near the inlet at Matanza Bar, was perhaps used as a lookout and signal station. A large part of this mound (Pl. LXXXIV) was removed from the northeast part and piled up on the remainder, forming a peak about 35 feet high. From this point a good view is obtained for several miles along the level country, and an approaching enemy could be easily seen. A covered way or ditch runs from the base to the summit, thus hiding those who were passing from the sight of the enemy.

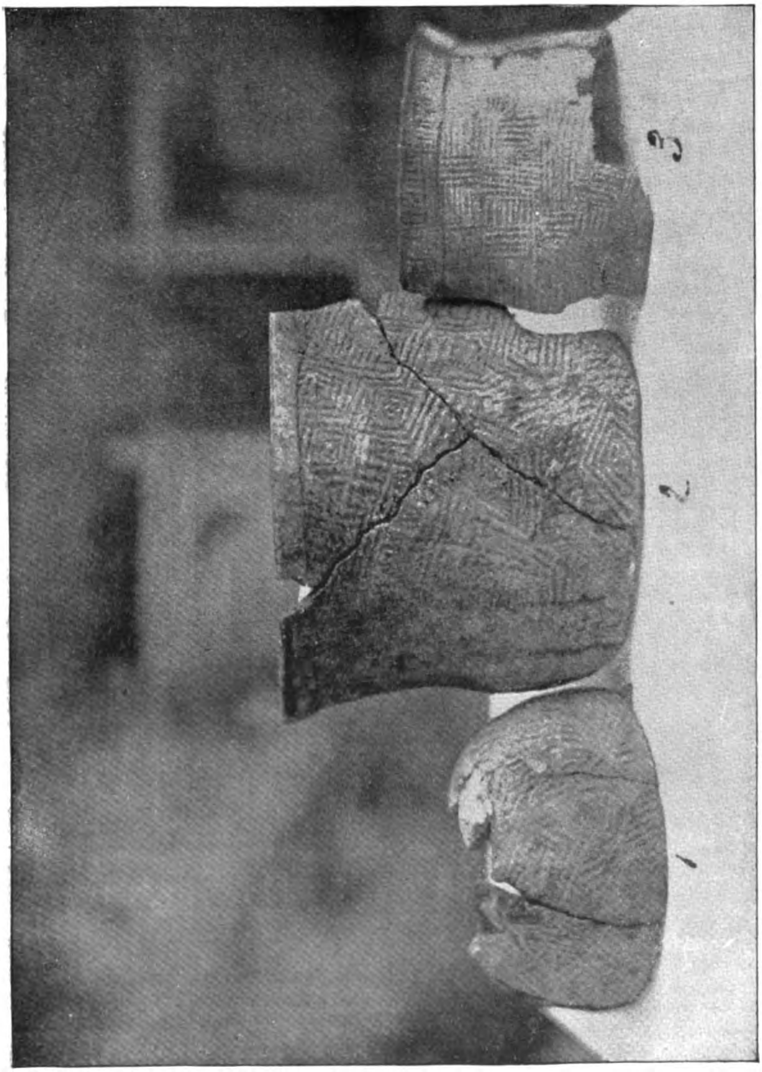
As to the age of these heaps all must be left to conjecture. Trees hundreds of years old are scattered over them. All instruments and implements of wood have long since perished, and not even a tradition of them remains. The shell heaps appear to me older than the earth mounds which some times adjoin them.



PERFORATED SHELLS FROM SHELL MOUNDS IN FLORIDA.
Used probably for dressing skin; two are prepared for use as clubs.

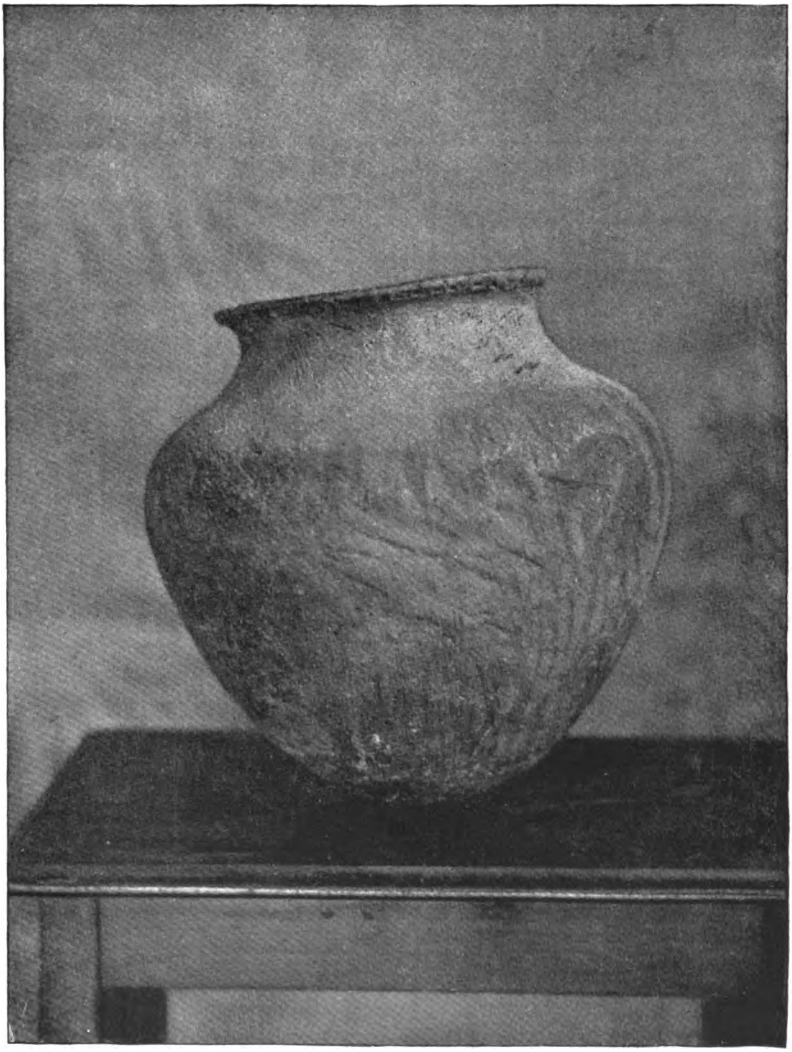


DRINKING-SHELLS FROM MOUNDS IN FLORIDA.

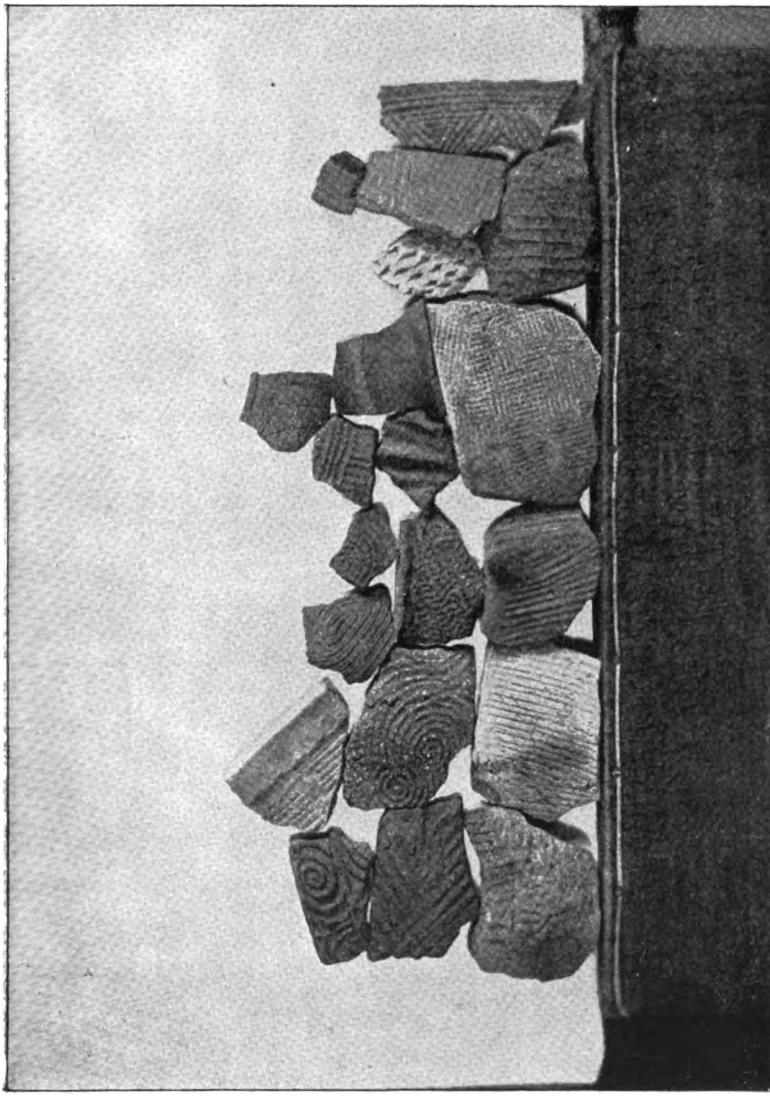


POTTERY FROM SHELL MOUNDS IN FLORIDA.

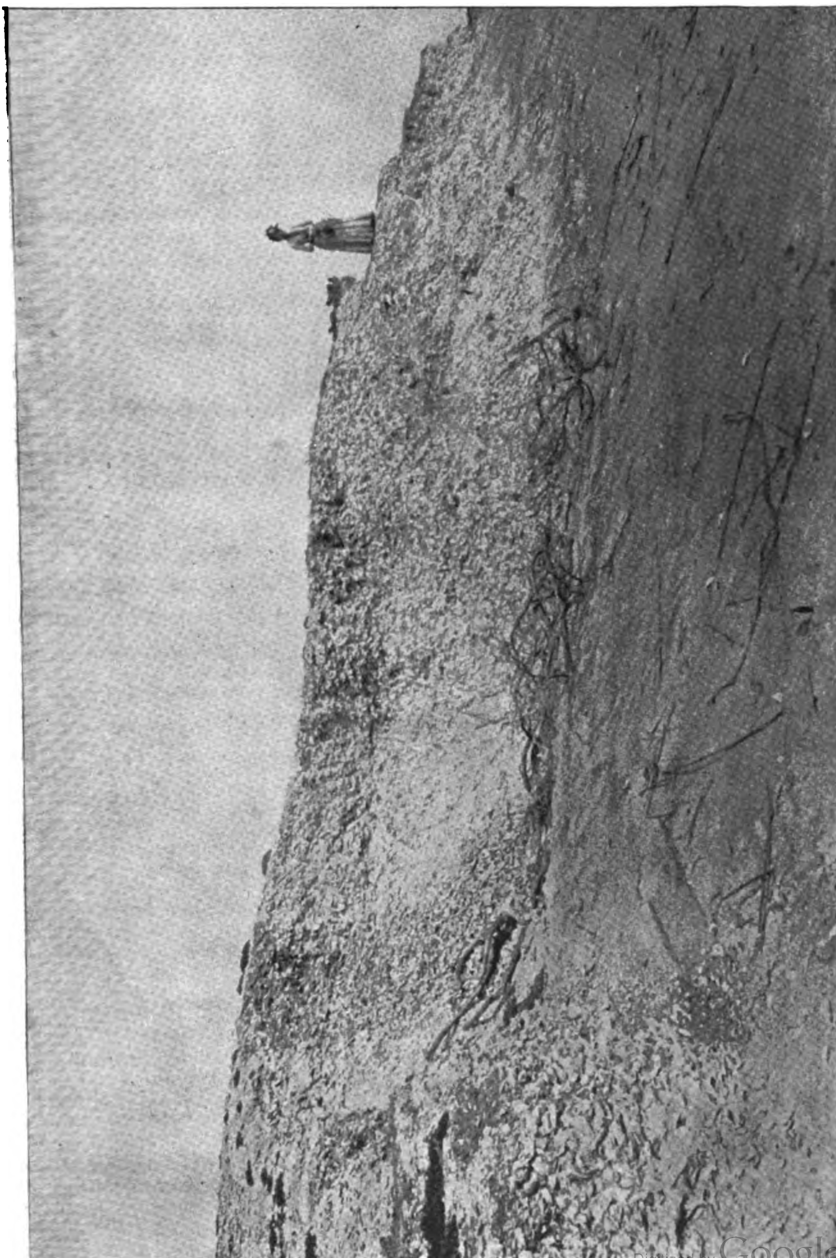
1. From mound near Old Fort Matanza. 2. From Anastasia Island. 3. From Fitzpatrick's Mound.



POTTERY FROM SHELL MOUNDS IN FLORIDA.
A perfect vessel from Homosassa, holding five gallons.

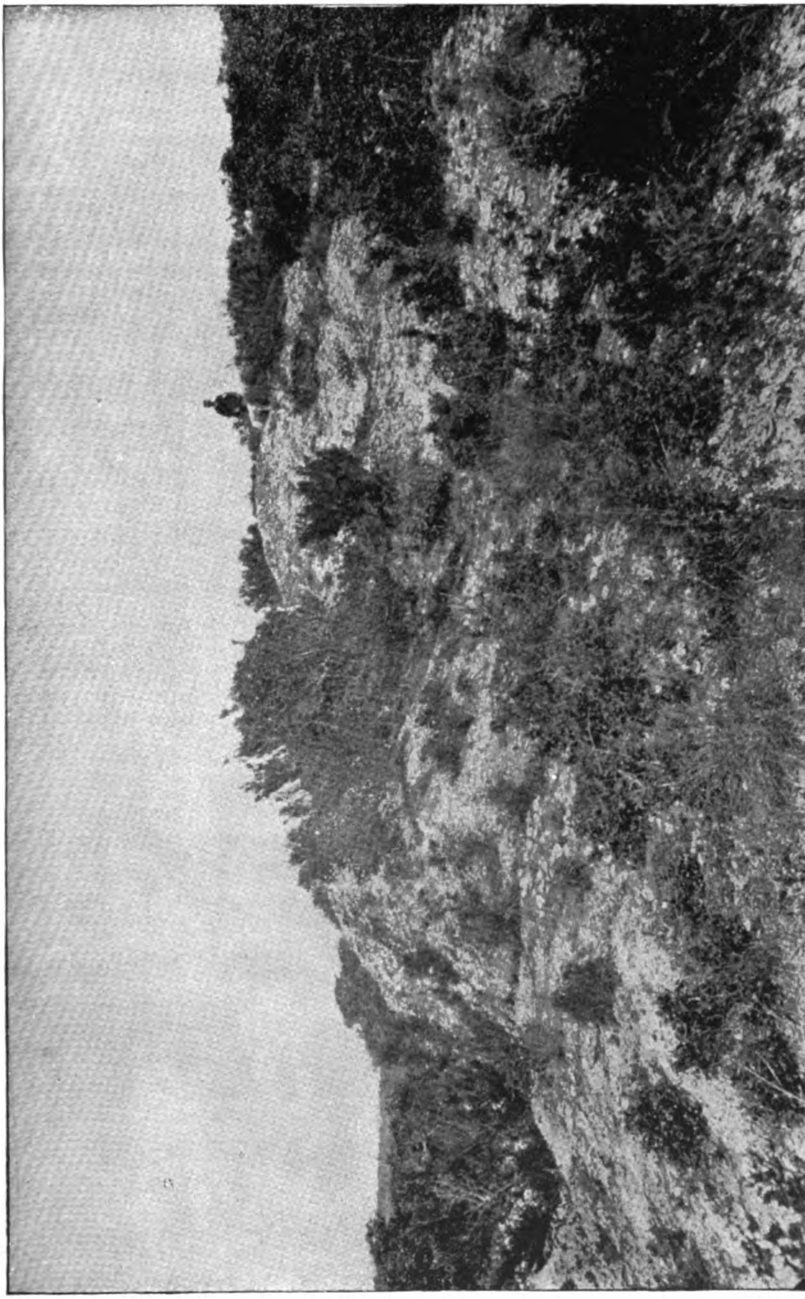


POTTERY FROM SHELL MOUNDS IN FLORIDA; SHOWING VARIETY OF DESIGN.



SEA FACE OF SHELL MOUND IN FLORIDA, LOOKING EAST.

The sea has washed away a large part of the mound and appears to be making further encroachments every year.



SHELL MOUND IN FLORIDA.

Made much higher than the original elevation by carrying material from the northeast side and heaping on the summit. Used as a signal station.

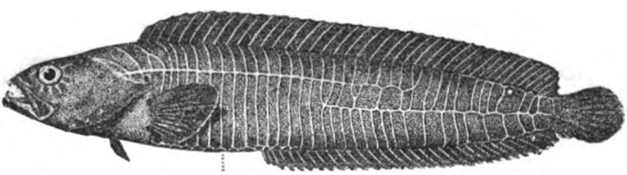
DESCRIPTION OF A NEW BLENNIOID FISH FROM CALIFORNIA.

BY

TARLETON H. BEAN, M. D.,

Assistant in charge Division of Fish Culture, U. S. Fish Commission.

During the month of June, 1893, car No. 2 of the U. S. Fish Commission made a collection of fishes at Monterey, Cal., for its aquarium at the World's Columbian Exposition. Among the species obtained and delivered in Chicago alive is a stichæoid fish, which resembles a *Gunnell* in general appearance, and yet differs in some essential characters, and appears to represent an undescribed genus and species. It may be introduced into the literature under the name



Plagiogrammus Hopkinsii.

PLAGIOGRAMMUS, new genus.

Body moderately elongate, compressed, covered with very small scales; lateral lines, 2; viz, one beginning above and slightly in advance of the upper angle of the gill opening, and extending along the upper part of the body, but not reaching to the tail; one beginning in advance of the end of this and reaching to the caudal; numerous lateral ridges on the sides, similar to those on *Dictyosoma* of Temminck and Schlegel; a series of subpentagonal plate-like bodies along the abdominal edge on each side between the ventral and the anal. Head moderately long, naked, with pointed snout; mouth oblique and rather large. The jaws subequal, or the lower slightly projecting; jaws with strong teeth in broad bands, the intermaxilla with an outer series of enlarged canine-like teeth; teeth on vomer and palate; a pair of large canines near the symphysis in each jaw, the canines of the upper jaw fitting into an interspace behind the mandibulary canines. A series of pores on the ramus of the mandibula continuing around the preopercular edge; a series of similar pores along the lower margin of the preorbital continued backward and upward towards the nape. Anterior nostril tubular; posterior without tube. Maxilla broadly expanded

posteriorly; lips well developed. Branchiostegals 5; gill membranes partly united, but free from the isthmus behind. Gill rakers minute, tubercular, in moderate number. A single long dorsal fin consisting of spines only. The spines longest in the posterior portion; anal fin lower than the dorsal, but similar in shape. Pectoral large, entirely below median line. Ventrals well developed, in advance of pectorals; caudal rounded, distinct. Intestinal canal short, with five small pyloric cœca.

Plagiogrammus Hopkinsi new species.

The type of the description, U. S. N. M., No. 44721, is a single example, 6 inches long, obtained at Monterey, Cal., June 22, 1893.

D. XLI; A. II, 29; r. I, 5; B. V. Scales about 95; ridges on side 32.

The greatest depth of the body, 1 inch, is contained 5¼ times in the total length without caudal. The length of the head—1 $\frac{5}{16}$ inches—is one-fourth of the total without caudal. The diameter of the eye is one-fifth of the length of the head. The snout is acute. The anterior nostril is tubular and nearer to the eye than to the tip of the snout. The posterior nostril is close to the upper anterior margin of the eye. The maxilla extends almost to the vertical through the hind margin of the eye. The intermaxilla is long and slender and reaches nearly as far back as the maxilla. The intermaxillary teeth are in broad bands, with an outer series of 5 or 6 large canines, those near the symphysis largest. The teeth in the mandible are in broad bands in front, followed by several enlarged canine-like teeth. A large canine on each side of the symphysis, the interspace between the two mandibulary canines receiving the canines of the intermaxilla when the jaws are closed. A row of 8 pores along the ramus of the mandible and the edge of the preopercle; another series around the lower margin of the preorbital bone as described for the genus. About 8 gill rakers on the first arch below the angle.

The distance of the dorsal origin from the snout is nearly equal to the length of the head. The spines are lowest in front; the longest spine is two-sevenths of the length of the head. The longest rays of the anal are near the end of the fin and scarcely exceed the length of the eye. The length of the pectoral equals that of the postorbital part of the head. The ventrals are close together; the inner rays longest—two-sevenths as long as the head. The caudal is rounded, its length nearly one-half that of the head. The vent is under the eleventh spine of the dorsal.

The upper lateral line begins above and slightly in advance of the upper angle of the gill opening, curves very slightly over the pectoral and extends to below the twenty-fifth spine of the dorsal, its distance from the dorsal edge equal to the diameter of the eye and also equal to its distance from the lower lateral line. The lower lateral line begins under the sixteenth spine of the dorsal and extends to the caudal. On each side of the abdominal ridge, between the ventrals and the vent,

are located about 10 subpentagonal plate-like bodies, the largest about one-half as long as the eye.

Color dusky brown; the fins black.

Little is known about the habits of the species, beyond the fact that in the aquarium it hides in rock crevices and seldom ventures from its hiding place. I take pleasure in associating with this blenny the name of Mr. Timothy Hopkins, of Menlo Park, Cal., the founder of the Seaside Laboratory at Pacific Grove, Monterey Bay, in commemoration of his services in behalf of science.

NOTES ON MYRIAPODA FROM LOANDA, AFRICA, COLLECTED BY MR. HELI CHATELAINE, INCLUDING A DESCRIPTION OF A NEW GENUS AND SPECIES.

BY

O. F. COOK.

A small collection of Myriapoda presented to the National Museum by Mr. Heli Chatelaine, formerly United States commercial agent at St. Paul de Loanda, was entrusted to me for study by Dr. Riley. This material supplements that collected by the United States Eclipse Expedition of 1889 and 1890*, and makes necessary some emendation of the former paper, including the establishment of a new genus of Iulidæ.

Spirostreptus variabilis Cook and Collins.

Ann. N. Y. Acad. Sci., VIII, 28, Pl. II, Figs. 11-14 (1893).

A mature male agrees entirely with the description and figures quoted. A female specimen 115 mm. long and with 55 segments has the clypeus very coarsely rugose, with the depressions between the antennæ not very apparent; the crescentic excavations lower down are very well pronounced. There are four punctations in the upper and seventeen in the lower row; teeth very broad and blunt. Lower edge of eyes slightly convex instead of concave. The eye-formulæ are, respectively, $13+12+11+10+8+6+4+2=66$ for the left eye, and $13+12+11+10+8+7+5=66$, a variation not recorded in the former description. The surface of the segments are without ridges, but have occasional very fine furrows. Anal valves scarcely wrinkled at base of margin. The exposed parts of the anterior subsegment are, in alcohol, yellowish buff.

Another female specimen 85 mm. long has 52 segments, the exposed parts of the anterior subsegments reddish, the crescentic depressions of the clypeus not evident, while those between the antennæ are much more apparent than in the other specimen.

In the Eclipse Expedition Myriapoda there were eight specimens, four males and four females, and there are thus eleven specimens of this species in the Museum.

*O. F. Cook and G. N. Collins: The Myriapoda Collected by the United States Eclipse Expedition to West Africa. Ann. N. Y. Acad. Sci., VIII pp. 22-40, Pl. I-III.

CTENOÏULUS, gen. nov.

Odontopyge of von Porath (probably), *not* of Brandt, Peters, and Karsch.

Body of moderate size, about 15 times as long as broad, cylindrical, narrowed, and slightly compressed posteriorly.

Covered portion of vertex with transverse and longitudinal striations.

Clypeus with two rows of setigerous punctations immediately above the labrum.

Labrum with shallow emargination and blunt teeth, which project nearly as far as the edges of the labrum outside the emargination.

Eyes pointed-oval or triangular-crescentic, distant from each other by more than the transverse diameter of one of them; ocelli 40–80 in number.

Antennæ subclavate, moniliate, second joint longest, followed by the third, sixth, fourth, fifth, first, and seventh; eighth joint distinct: olfactory cones large, widely separated.

Mandibulary stipe with exposed surface convex, subrectangular; margin plane or elevated.

Masticatory plate rounded triangular, about twice as long as broad, divided into a flat triangular, roughened surface with a raised margin and a broad groove.

Mandibulary tooth large, triangular, with rounded apex, about twice as long as the breadth of base.

Dentate lamella with five blunt teeth.

Pectinate lamellæ, nine.

Hypostoma more or less arcuate, the ends enlarged and with a chitinized projection on the posterior edge.

Mentum of male with the ends very narrow, that of the female oblong.

Promentum semi-elliptical triangular, broadest behind, rounded in front; a narrow posterior portion with the surface plane, the larger anterior part concave, with a distinct line of demarcation.

Cardo small, subtriangular.

Stipe between two and three times as long as its greatest width.

Lingual lamina subequal in length with the promentum, half as wide as the stipe.

First segment with the lateral lobes rounded or somewhat truncate, with one or two oblique striations.

Anterior subsegments concentrically striate anteriorly, and with scattered granules along the striations.

Posterior subsegments finely, longitudinally rugulose; coarser striations on the lateral and ventral surfaces.

Supplementary margin regularly pectinate.

Repugnatorial pores beginning on the sixth segment, absent from the last two segments and sometimes from the fourth from the last; pores located near the middle line of side.

Pedigerous laminæ punctate-areolate, not transversely striate.

Last segment carinate on the median line above, completely closed below.

Anal valves carinate near the margins, the carinæ produced above into a larger or smaller subconic, pointed mucro.

Legs 6-jointed, the first joint short, the others subequal, with the fourth slightly longest; males with membranous cushions on the ventral face of the fourth and fifth joints; cushions wanting on the first five and last two pairs; seven pairs in front of the genitalia, first three pairs with pedigerous laminæ free.

First pair of legs of males 5-jointed, the basal joint with a large curved process directed cephalo-laterad.

Genitalia of male with the flagellum expanded and lamellate.

Segments 54–69, length 30–8mm.

DISTRIBUTION: The species typical of the above genus has been found only at St. Paul de Loanda, but several other species, probably congeneric, are known from Caffraria, so that the genus will probably be found throughout southern Africa.

This genus differs from *Spirostreptus* in the nine pectinate lamellæ, the shape of the mentum and promentum, the pectinate supplementary margin, the repugnatorial pores wanting on the penultimate segment, the membranous cushion of the two penultimate joints of the male legs, and the lamellate flagellum of the male genitalia. How far any individual character will prove to be diagnostic of the genus can not, of course, be inferred, but size, shape, habit, and coloration enforce the opinion that the present is a new generic type.

From the species of *Spirostreptus*, subgenus *Nodopyge*, the spinal anal valves are a distinguishing feature. Whether the two subgenera of *Spirostreptus* ought not to be given generic rank, remains to be determined; the spined anal valves, if a constant character, should be given, it would seem, as much weight as the additional pore of *Alloporus*.

Ctenoiulus chatelainei, sp. nov.

Odontopyge furcata (Karsch). Ann. N. Y. Acad. Sci., VIII, 36, Pl. III, Figs. 24–28, not *Spirostreptus* (*Odontopyge*) *furcatus* Karsch, neue Juliden des Berliner Museum, p. 22.

Body of males slightly constricted behind the head.

Covered portion of epicranium with two well-pronounced transverse striations, the space between which is finely striate longitudinally.

Vertex smooth or very finely striate longitudinally; sulcus obsolete, but the suture distinct, as well as the transverse intra-ocular suture which it joins.

Clypeus smooth, sometimes with a large shallow depression below the middle; upper row of 5–8 punctations, lower row of 16–20; each of the punctations has a bristle, some of which are .125 mm. long.

Eyes pointed oval, distant from each other by more than the trans-

verse diameter of one of them; ocelli subequal, arranged $11+10+9+8+7+5+3=53$.

Antennæ 4 mm. long, the fifth and sixth joints together longer than the second.

Mandibulary stipe with anterior edge of exposed surface broadly emarginate.

Mentum oblong, about six times as broad as its median length, posterior corners rounded in the female, in the male replaced by a membranous pouch into which fits the large process of the copa of the first pair of legs.

Promentum without bristles.

Stipe of gnathochilarium with scattered bristles along the promentum and the anterior half of the lateral margins.

Lingual laminæ with a few short bristles at base, and three long ones toward the anterior margin.

First segment smooth, anterior angle rounded; one complete and deep striation, and a branched, more shallow, marginal striation.

Anterior subsegments with seven or eight concentric striations on the anterior portion, the striations with small protuberances about as far apart as the striations are from each other; some of the protuberances not on the striations, but located without regularity on that part of the subsequent which is behind the striations.

Posterior subsegments with fine curved and branching wrinkles whose general direction is longitudinal; the coarser striations of the sides and inferior surface begin about two-thirds of the distance from the median line to the repugnatorial pore, but the striations above the pore are very short and to be found only along the suture.

Supplementary margin finely and equally pectinate, 0.055 mm. long, including the teeth, which are 0.01 mm. long, broad at base, pointed; sinews between teeth rounded, 0.01 mm. broad.

Repugnatorial pores longitudinally elliptic, 0.04 mm. long, situated at the middle line of side, nearer to the nearly straight suture than to the posterior margin of the segment. In front of the pore the surface of the segment is smoother, and immediately behind the pore is a more or less evident depression. On male specimens the fourth segment from the end may have no pores. Sometimes there is a pore on one side and not on the other.

Last segment rugose above, smoother below and finely punctate, strongly carinate on the median line above; posterior angle somewhat produced, rounded.

Anal valves rugulose-punctate, each with a prominent carina which incloses a crescentic space between it and the moderately prominent, slightly compressed margins; the carina is produced above into a large, usually sharp-pointed mucro, curved slightly cephalad at apex.

Pre-anal scale punctate, rounded, nearly twice as broad as long.

First pair of legs with the process of coxa tuberculate-wrinkled, a

setigerous punctation near the distal end of the anterior face of the coxa.

Color of alcoholic specimens chestnut-brown, alternating with yellow; anterior portion of each posterior subsegment brown, the posterior margin and usually a broad dorsal median line, yellow or buff; feet pale reddish, antennæ chestnut-brown; anterior and ventral portions of segments buff. In the young the colors are paler and less distinct, so that the general color appears to be a dirty yellow.

Length of larger specimens 60 mm., diameter 4 mm.; 61–64 segments.

HABITAT.—St. Paul de Loanda. Mr. Chatelaine's collection contains three female specimens and several others in more or less fragmentary condition. This additional material has made necessary some changes in the specific description quoted above, and many of the characters previously placed in it have been relegated to the new generic description.

The spined anal valves appeared to Mr. Collins and myself so remarkable a feature that we were inclined to believe them characteristic of a genus, and rather than establish a new genus we preferred to believe that there was some mistake about Dr. Karsch's statement to the effect that the species described by him under *Odentopyge* had no pectinate supplementary margin. Since the former paper was written, the study of a more extensive collection of African Iulidæ has established the fact that the spined anal valves exist in several genera, and are found in forms which have the supplementary margin entire.

It therefore becomes necessary to distinguish the present and allied forms from the other described groups, and when studied with such a purpose in view, the differences from *Spirostreptus* are evidently such as to demand a separate description, not merely the establishment of *Spirostreptus*, a genus no longer adequately definable by reason of the diversity of forms now referred to it.

Porath has described five species with pectinate supplementary margins and other characters which render it probable that they are congeneric with the above, and the generic description has been drawn up to accomodate them. They are *Ctenoiulus foveolatus*, *puncticaudus*, *aequalis*, *dimidiatus*, and *prætextus*, the last with the apices of the teeth of the supplementary margin connate. As Dr. Karsch has examined the type of *Spirostreptus dimidiatus* Peters, and finds the supplementary margin entire, it is probable that Porath's *dimidiatus* is distinct, and the name should be changed as Dr. Karsch has suggested.

All Porath's species are from Caffraria, distant from Loanda by 20 degrees of latitude, and the descriptions do not include the characters of the mouth-parts, legs or genitalia, so that their generic affinities can not be determined with confidence, hence it can only be said that from what is known of them they seem to belong to the present genus rather than to any other.

From the West Coast of Africa three species of *Odontopyge* have

been described, *acutus*, *angolensis*, *furcatus*, the first two from Angola, the third from the Gold Coast, so that no differences of distribution can, as yet, be alleged between the two allied groups. On the East Coast, however, the case seems somewhat different, for nine species of *Odontopyge* have been described from the tropical region, while none were found in Caffraria.

Scolopendra morsitans Linn.

Nine specimens, varying from 60–80 mm. in length, and with no characters longer noteworthy in so variable a species.

Huntington, N. Y., 29 Aug., 1893.

DESCRIPTION OF A NEW SPECIES OF BLIND-SNAKES (TYPHLOPIDÆ) FROM THE CONGO FREE STATE.

BY

LEONHARD STEJNEGER,

Curator of the Department of Reptiles and Batrachians.

The National Museum is under obligations to Mr. J. H. Camp for a small, but very interesting collection of reptiles and batrachians from Leopoldville and Stanley Pool. One of the species sent proves to be new and may be described as follows:

Typhlops præocularis, sp. nov.

DIAGNOSIS.—A preocular, not in contact with supralabials; no suboculars; ocular in contact with nasal below preocular, reaching lip behind second supralabial; snout with sharp horizontal edge.

HABITAT.—Congo Free State, Africa.

Type.—U. S. National Museum, No. 20799; Leopoldville, or Stanley Pool, Congo Free State; J. H. Camp coll.

Description.—Snout very prominent and pointed, but not hooked, with sharp cutting edge; nostrils inferior, situated just beneath the cutting edge, between two large nasals almost at the point where the internasal suture joins the rostral; rostral very large, about two-thirds the width of the head, the portion visible from below wider than long; labial border of rostral concave, without the usual central prolongation backwards; anterior nasal half-moon shaped, the outer edge nearly parallel with the rostral, the nasal cleft proceeding from the lower border of the rostral, ending at the rostral just below the cutting edge; posterior nasal at the cutting edge as wide as the preocular and ocular together, becoming narrower above and below, in contact above with prefrontal and supraocular, below with second supralabial and ocular; preocular about as wide as ocular, below widely separated from the supralabials by the posterior nasal and ocular; ocular rather narrow, below anteriorly in contact with posterior nasal, and second supralabial reaching the lip behind the latter; eyes indistinguishable; first supralabial exceedingly small, forming the edge of the lip below the anterior nasal, anteriorly receding within the mouth behind the rostral, being separated from the corresponding labial on the other side by a small squarish scale behind the rostral; second supralabial rather larger, in contact with first supralabial, anterior and posterior nasal and ocular, its upper posterior corner wedged in between the two last-mentioned shields; a long and narrow shield behind the lower posterior

edge of the ocular represents what is ordinarily the fourth supralabial, its anterior point, however, barely reaching the lip; prefrontal and frontal subequal, wider than long; subocular and parietal subequal, wider than long, somewhat wider than frontal; one mental; two sublabials; diameter of body at the middle 67 times in the total length, the body growing thicker posteriorly; tail very short, wider than long, ending in a short spine; 24 to 26 scales round the middle of the body. Uniform, pale brownish gray, scarcely paler below. Total length 340 millimeters.

Remarks.—This very distinct species seems to be quite unique in the way in which the facial shields border the upper lip. The rostral, as described above, forms the anterior border as usual, but instead of this consisting of a narrow square projection backwards, the lower free border of the rostral is distinctly concave forward. The posterior projection, however, can be detected under the microscope as a separate small scale inside the mouth back of the rostral, separating the two exceedingly small but elongated anterior supralabials from each other by barely discernible sutures, while the suture separating it from the rostral is very distinct. The next peculiarity of the upper labial border consists in the absence of the third supralabial, in place of which the lower end of the ocular reaches the lip, while the fourth (in this case third separate) labial is forced backward. Another rather uncommon feature is the exclusion of the preocular from the supralabials, the posterior nasal and the ocular being broadly in contact below it. The snout from below, therefore, superficially somewhat resembles that of one of the *Leptotyphlopidae*. The nostrils are placed uncommonly close to the rostral, being situated almost at the junction of the cutting edge with the rostral and internasal sutures.

Altogether this is a very remarkable form which seems to have no particularly close relationship to any of the hitherto known species.

ON SOME COLLECTIONS OF REPTILES AND BATRACHIANS FROM EAST AFRICA AND THE ADJACENT ISLANDS, RECENTLY RECEIVED FROM DR. W. L. ABBOTT AND MR. WILLIAM ASTOR CHANLER, WITH DESCRIPTIONS OF NEW SPECIES.

BY

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The collections treated of in the present paper were sent home at various times by the gentlemen mentioned in the title. In addition to these I have enumerated several specimens, chiefly from the Seychelles, collected by the late Col. Nicolas Pike, and presented by him to the Museum, as well as a few others from the same islands obtained from the British Museum, in 1883, and the Paris Museum, through Prof. Léon Vaillant, during the present year.

Dr. W. L. Abbott's collections from the base of the Kilima-Njaro were made during 1888 and 1889, and the specimens mentioned in the following pages were probably taken at altitudes between 5,000 and 8,000 feet above the sea.

He collected twice on the Seychelles, viz, in April and May, 1890, and again in 1892 during the months of July and August. In October, November, and December of the same year he collected in Aldabra. The reptiles obtained in Gloriosa Island were taken during the latter part of January, 1873.

The collection received from Mr. William Astor Chanler was made by him and Lieut. von Hœhnel, of the Imperial Austrian Navy, along the Tana River, en route from the coast to Hameye, about 300 miles inland. His expedition left Mkoumbi, on the coast of Witu, on September 18 and reached Hameye on November 26, 1892, following the left bank of the Tana from Merifano to Subaki, where he crossed over to the right bank. He also presented the Museum with a small, but interesting collection made by Mr. Gustav Denhardt at Wange on the island of Manda, a short distance north of Lamu.

Mr. Chanler's collection is chiefly interesting in furnishing material from a region between that of the Massai land and Somali. Species found hitherto only in the latter country are among Mr. Chanler's treasures, while the range of several southern forms have been extended northward.

The most interesting portion of Dr. Abbott's collections are undoubtedly the specimens obtained in the Seychelles, Aldabra, and Gloriosa. So far as I know no extensive collecting has been done in the last men-

tioned islands.* The herpetological result is only three species of lizards in each island, but it is not supposed that the fauna of these islands is exhausted. The following is a list of the species collected by Dr. Abbott:

Gloriosa.

Hemidactylus mabouia.
Zonosaurus madagascariensis.
Ablepharus gloriosus.

Aldabra.

Phelsuma abbotti.
Hemidactylus mabouia.
Ablepharus poecilopleurus.

The Seychelles, on the other hand, are by this time pretty well explored, though it is to be regretted that the collectors so far have neglected to furnish data by which it would have been possible to ascertain the distribution of the species in the various islands composing the group. Nevertheless, Dr. Abbott's collections have added several additions to the fauna of these interesting islands, including two species hitherto undescribed, one of which belongs to a genus hitherto only found in Australia.

The only list of the reptiles and batrachians of the Seychelles, so far as I know, is given in Wallace's *Island Life* (London, 1881, pp. 395–397). He enumerates eleven species as found in the group, five of which he considers peculiar to the islands. Since then it has been learned that two of the species enumerated by him, viz, *Boædon geometricus* and *Caecilia rostrata*, in reality are peculiar, though at that time supposed to occur in other localities as well, making the peculiar species seven. To-day we know fifteen land species as occurring with certainty, ten of which are peculiar, while a number of additional names may be regarded as of doubtful occurrence. The following is a revised list, the full explanation of which will be found further on in this paper. under the head of the various species. The names in brackets are those of Wallace's list:

SEYCHELLES.

* Denotes that the species is considered peculiar to the group.
† Denotes that specimens are in the U. S. National Museum.

REPTILIA.

(*Chelone imbricata*, fide Peters, Monatsb. Berlin, 1866, p. 887.)
†1. *Sternothærus nigricans.*
?*Sternothærus sinuatus.*
†2. *Hemidactylus mabouia.*
?*Hemidactylus frenatus.*
*†3. *Diplodactylus inexpectatus.*
†4. *Phelsuma madagascariense* [Ph. cepedianus].

*One species of lizard is so far recorded from Gloriosa by Dr. Günther as *Gerrhonotus madagascariensis* (Zool. Coll. 'Alert,' 1884, p. 486) evidently a lapsus for *Zonosaurus madagascariensis.*

*†5. *Ailuronyx seychellensis* [Phelsuma s.].
6. *Peropus mutilatus* [Wallace].
*†7. *Mabuya sechellensis* [Euprepes cyanogaster].
*†8. *Chamæleo tigris* [Wallace].
*†9. *Lycognathophis seychellensis* [Dromicus s.].
*†10. *Boædon geometricus* [Wallace].

BATRACHIA.

*†11. *Megalixalus seychellensis* [M. infrarufus].
†12. *Rana mascareniensis* [R. mascariensis].
? *Uræotyphlus oxyurus* [Cæcilia oxyura].
*13. *Cryptopsophis multiplicatus*.
*†14. *Hypogeophis rostratus* [Caecilia rostrata].
*†15. *Hypogeophis alternans*.

I. REPTILIA.

LORICATA.

Crocodylus niloticus LAUR.

Mr. Chanler sends a small specimen from the Tana River (No. 20071), and Dr. Abbott a nearly grown one; exact locality not given (No. 16027).

TESTUDINES.

Sternothærus nigricans (DONND.).

There are four *Sternothæri* in the collections sent home by Dr. Abbott, three from La Digue Island, Seychelles (U. S. National Museum, Nos. 19802-19804) and one dried specimen from Gloriosa Island (No. 29347, Dept. Comp. Anat.).

The determination of this species (for most certainly all four specimens are strictly conspecific) has caused me considerable doubt from the fact that Boulenger, among the British Museum specimens, enumerates one specimen from La Digue under *S. sinuatus* (Cat. Chel. Br. Mus., p. 195). I have no undoubted specimen of the latter species to compare with, and consequently have to rely on the literature. Now, *S. nigricans* is said by Boulenger (*op. cit.*, p. 195) to have the upper jaw neither hooked nor bicuspid, and it is very certain that our specimens can not fairly be called "bicuspid," though there is an indication of a notch with the faintest possible swelling on both sides. Then again he states that in this species "the frontal suture [is] not or but slightly exceeding the width of the interorbital space," while in *S. sinuatus* "the interorbital width [is] considerably less than the longitudinal suture between the frontal shields." This would most certainly make our specimens *S. nigricans*, as in all of them the interorbital space is at least as wide as the length of the frontal suture.

In addition to this our specimens agree exactly with the characters given by Peters (Reise Mossamb., Zool. Amph., p. 8) as characteristic of *S. nigricans* in as much as the posterior margin of the carapace is not serrated, the median marginals are not keeled and hardly visible when the carapace is viewed from above. I may also mention that Peters has identified another specimen from the Seychelles (Mahé Island) as *S. nigricans* (Monatsber. Akad. Wiss. Berlin, 1877, p. 455).

Finally, if Smith's plate representing *S. sinuatus* (Ill. Zoöl. S. Afr. Rept., pl. i) is only approximately correct, our specimens can not well belong to that species.

The largest specimen (No. 29347) has a shell 160 mm. long.

SAURI.

Hemidactylus mabouia (Moreau).

Of this widely distributed species our collectors have brought specimens from nearly all the localities visited.

Mr. Chanler has one from the Tana River (U. S. National Museum, No. 20087).

Dr. Abbott sends two large specimens labeled Kilima-Njaro (Nos. 16748–16750). He has also two specimens from the Seychelles (Nos. 20454–20455) in pretty poor condition. I am not aware that this species has been collected in these islands before.* It would be interesting to know in which particular island they were obtained.

Three more specimens from Gloriosa Island (Nos. 20459–20461), also collected by Dr. Abbott, have apparently been taken from the stomach of some bird, as they appear to be half digested. I have no doubt about the correctness of the identification, though the tubercles on the back are rather large.

The same gentleman, finally, has three specimens from Aldabra Island, one of them quite young (Nos. 20470–20472). I can discover no other difference from typical specimens than the separation of the second chin-shield from the second infralabial by two small scales, identical in both the grown specimens, while in all the other specimens of *H. mabouia* before me the second chin-shield is in contact with the second infralabial.

Diplodactylus inexpectatus, sp. nov.

Diagnosis.—Back covered with uniform granular scales; digits with regular transverse lamellæ inferiorly; rostral and first labial entering nostril; digital expansion considerably wider than digit, two-thirds the

*Boettger (Abh. Senckenb. Ges., XII, 1881, p. 531) records *Hemidactylus frenatus* as occurring in the Seychelles, but upon what authority I do not know. It may perhaps not be unnecessary, in view of this record, to state emphatically that the specimens collected by Dr. Abbott are true *H. mabouia*, with well-developed inner digits and tubercles on the postocular portion of the upper surface of the head.

diameter of the eye; 12 entire lamellæ under the fourth toe; ear-opening small, one-third the diameter of the eye.

HABITAT.—Ile Mahé, Seychelles.

Type.—U. S. National Museum, No. 20433; Dr. W. L. Abbott coll.

Description.—Snout considerably longer than the distance between the eye and the ear-opening; ear-opening small, rounded; digits rather long, slender, feebly depressed, inferiorly with large, undivided, transverse lamellæ, 12 under the fourth toe, which are broken up into small tubercles some distance before the distal expansion; the latter cordiform, considerably wider than digit, two-thirds the diameter of the eye; digits above, including the upper surface of the expansion covered with small granules like those on the back; upper surface of body and limbs, as well as tail above and below covered with small uniform granular scales, somewhat larger on snout and tail; rostral four-sided, fully twice as wide as high, without cleft above; nostril pierced just above the suture of the rostral with first labial, between both the latter and three small scales; three scales along the upper border of the rostral between the anterior supero-nasals; eleven supralabials, first largest; ten infraabials; mental trapezoid, not larger than the adjacent labials; no chin-shields, but small polygonal scales passing gradually into the minute granules of the gular region; abdominal scales small, about the size of the caudal granules, but smooth, roundish hexagonal, slightly imbricate; tail cylindrical, tapering, with uniform granulation; two enlarged granules close together on each side of the base of tail; no preanal pores.

Color (in alcohol) above dark brownish gray, with indistinct darker marbling on head and sides; traces of dark cross bands on lower back; below whitish; labials white; a pale stripe from nostril through upper part of eye to above ear-opening bordered below by a dark line; digits cross-barred with dusky.

Dimensions.—Total length, 75 mm.; tip of snout to ear-opening, 9 mm.; width of head at ear-opening, 7 mm.; fore limb, 11 mm.; hind limb, 17 mm.; tail, 35 mm.

Remarks.—The discovery of a new gecko of the phyllodactyl group in the principal island of the Seychelles is not so very surprising, because in the first place the reptile fauna of these islands is probably not yet thoroughly explored, while in the second place other species of the same group, as for instance *Phyllodactylus oviceps*, *Ph. sancti-johannis*, *Ph. stumpffi*, *Ph. porphyreus*, *Ph. pictus*, and the two species of *Ebenavia*, inhabit either Madagascar or some of the surrounding islands. The surprise is, however, that the new species belongs to the genus *Diplodactylus*, as now understood by Boulenger, all the hitherto known species of which are confined to Australia. That the present species really is a *Diplodactylus* can not be doubted, for the digits are "not dilated at the base, clawed, the distal expansion covered above with small tubercular scales similar to those on the basal part," the sub-digital transverse lamellæ are undivided, and there is no penul-

timate expansion. However, in view of the fact that the genus *Phyllodactylus*, which unquestionably is closely allied, has a similar and even wider distribution, the present extension of the range of *Diplodactylus* can not be considered particularly abnormal, while the discovery of a species of the nearly related Australian genus *Oedura* in southwestern Africa a few years ago (*Oedura africana* Boulenger, Ann. Mag. N. H. (6) II, Aug. 1888, p. 138) is even more startling.

Phelsuma abbotti, sp. nov.

DIAGNOSIS.—Nostrils pierced above the first upper labial only; ventral scales smooth; snout not twice as long as the distance between orbit and ear-opening; chin shields much larger than adjoining gular scales; tail not much depressed, narrower than the body; 33 femoro-preanal pores altogether; segments of tail not very distinct, composed of six transverse rows of scales on the side as well as on the upper surface.

HABITAT.—Aldabra Island.

Type.—U. S. National Museum No. 20467; Dr. W. L. Abbott coll.

Description.—Snout once and two-thirds as long as the distance between the eye and the ear-opening, twice the diameter of the orbit; upper part of rostral with a median cleft; nostril pierced above and bordered beneath by the first supralabial; supralabials seven to eight; infralabials seven; chin shields four on each side, gradually decreasing in size, inner pair about four times as large as outer; one to three scales between the naso-rostrals; ear-opening small, its vertical diameter not half that of the orbit; dorsal scales small, keeled from the head; ventral scales smooth; femoral pores thirty-three altogether; tail not very much depressed, narrower than the body; segments of tail rather indistinct, composed each of six transverse rows of rather large, flat scales both on sides and upper surface; lower surface of tail (when intact) with a median series of transversely dilated scales, two narrower ones alternating with a wider one. Color (in alcohol) dark olive slate above, on the sides gradually passing into the whitish of the under surface; a black line from nostrils through eye to neck; supralabials and a broad band backward to over the ear-opening whitish; sides and upper surface of limbs coarsely marbled with blackish.

Measurements (in millimeters).

U. S. National Museum number	20467	20468	20469
Sex	♂	♂	♀
	mm.	*mm.*	*mm.*
Total length	127.0	115	86
Tip of snout to ear	15.0	13	12
Width of head at ears	11.5	11	9
Fore limb to tip of longest finger	20.0	18	14
Hind limb to tip of longest toe	23.0	21	15
Tail (intact)	70.0	64	....

Remarks.—The present species, in its general features, resembles *Ph. madagascariense*, having the same arrangement of the scales surrounding the nostrils, but it has a considerably shorter and somewhat broader snout, and the supralabials are higher. It is probably also a much smaller animal, as the specimens before me have every appearance of being full grown. The coloration is also very different when compared with individuals of the same size from the Seychelles, the lateral stripes of the head being quite characteristic.

In some respects, especially the length of the head, *Ph. abbotti* approaches *Ph. laticauda*, but the shape of the tail of the latter seems to be quite different, while in the former it is exactly like that of *Ph. madagascariense*. From both of these species, as well as from *Ph. cepedianum*, from Mauritius, our new species differs in the much greater size of the scales which cover the upper and lateral surfaces of the tail, these scales being regularly hexagonal and flat. Boettger's description of these scales in *Ph. dubium*, from Nossi Bé, as quoted by Boulenger, Cat. Liz. Br. Mus., I, p. 215, is not explicit enough, but it would seem as if they may be similar to those in *Ph. abbotti*. From Boettger's species the latter seems easily distinguishable by its large chin shields which are fully as well developed as in *Ph. madagascariense*, while in *Ph. dubium* they appear to be more like those of *Ph. cepedianum*.

Agama colonorum DAUD.

Six specimens (U. S. National Museum, Nos. 20081–20086) collected by Mr. Chanler at the Tana River are so much alike typical western specimens that I am unable to separate them. The eastern ones have possibly the nuchal crest on the average consisting of fewer (10–12) and slightly larger spines than in specimens from the West Coast (12–15).

It will be noticed that Peters records *A. congica*, which Boulenger unites with *A. colonorum*, as having been collected by Hildebrandt at Ukamba (Monatsber. Ak. Wiss. Berlin, 1878, p. 202).

Varanus saurus (LAUR.).

By recording the two young specimens collected by Mr. Chanler on the Tana River (Nos. 20072–20073) as above I wish to express the fact that they have the scales on the nape larger than the dorsal scales, as Peters asserts that the reverse obtains in true *V. niloticus* from Northern Africa.

Latastia spinalis (PETERS).

A single specimen of this species, hitherto found only in Abyssinia, was collected by Mr. Chanler on the Tana River (U. S. National Museum, No. 20076). This discovery is the more interesting since Boettger has recently described a nearly related new *Latastia* from Lafarug, Somaliland, but this species, *L. heterolepis*, is distinguished by having

the supraoculars entirely surrounded by granules (Zool. Anz., XVI, April 10, 1893, p. 115).

From Boulenger's description (Cat. Liz. Br. Mus., III, p. 57) our specimen differs only in having all the gular granules of the same size, the four posterior rows, including the edge of the collar, suddenly appearing as flat, subequal scales, while Boulenger says: "Gular scales moderate, gradually increasing in size toward the collar."

From Peters' original description and figure (Monatsber. Akad. Berlin, 1874, p. 369, pl. — fig. 2) our specimen differs chiefly in having a narrow but elongate interparietal; in having the frenal divided off anteriorly; in having the subocular between fifth and sixth supralabials; and in having only one series of very wide brachial plates covering the outer aspect of the humerus.

In our specimen the average number of scales across the body is 38; ventral shields in 27 transverse rows; two enlarged median preanals surrounded anteriorly and laterally by a row of smaller scales; femoral pores 11 on each side.

In coloration our specimen agrees very well with Peters description of the type.

Eremias sextæniata, sp. nov.

DIAGNOSIS.—Ventral plates in six straight subequal longitudinal series; lower nasal undivided, resting on first labial only; supraoculars entirely surrounded by granules; upper head-shields strongly striated; subocular excluded from lip by one or two supralabials; back with six pale longitudinal bands, including five darker clay-colored bands, which contain each a series of numerous black spots.

HABITAT.—Tana River, East Africa.

Type.—U. S. National Museum, No. 20080; W. A. Chanler coll.

Remarks.—Differs from *E. spekii* chiefly in the exclusion of the subocular from the lip and in the coloration.

Two specimens were collected by Mr. Chanler (Nos. 20079–20080), both having the subocular excluded from the lip by well-developed supralabials, two on both sides of No. 20080, while two on one side and one long one on the other side in No. 20079.

On the other hand it appears that the types of *E. spekii* (two specimens in British Museum) as well as the types of *E. rugiceps* Peters (how many? Boulenger, Cat. Liz. Br. Mus., III, p. 84, footnote, says "Types (Mus. Berol. 9287) examined") all have the subocular bordering the lip.

This character might be supposed to be subject to individual variation, and I have no material at hand that will throw any light upon this subject, but I find that Boulenger (*tom. cit.*) when describing species of which British Museum contains very large series (for instance, *E. guttulata*, pp. 88–89, 28 specimens; *E. arguta*, p. 102, 28 specimens) does not mention any variation in this character, although he always notes the irregularities in the numbers of the adjoining supralabials.

The coloration, moreover, seems to offer another tangible difference. Boulenger describes *E. spekii* as being "brownish above, with three longitudinal paler lines, and a more indistinct one along each flank; small black cross bars between the light streaks" (Cat. Liz. Br. Mus., III, p. 84), and Peters also describes the synonymous *E. rugiceps* as having five longitudinal pale lines, of which the middle one bifurcates anteriorly, (Monatsber. Akad. Berlin, 1878, p. 203). Our specimens, on the contrary, have 6 distinct pale lines, the median line, like the other dark interspaces being marked with a series of black spots. The number of these spots averages in each row eighteen to twenty.

Eremias brenneri PETERS.

The specimen (No. 20078) collected by Mr. Chanler on the Tana River agrees in all essential points with the characters given by Boulenger in the description of E. *brenneri*, as distinguished from *E. mucronata* (BLANFORD) (Ann. Mus. Genova (2), XII, 1892, p. 8). It has the upper head-shields strongly striated, and the upper caudal scales strongly keeled.

The specimen seems, in fact, to be perfectly typical, except that it has the anterior three chin-shields in contact, a difference evidently within the individual variation. The subocular is excluded from the lip, being wedged in between the sixth and seventh supralabials on the right side, but between the seventh and eighth on the left side. There are, moreover, five elongate infralabials on each side, followed by two or three rows of small hexagonal scales. The top of the head is also normal, but the interparietal is quite minute. With these exceptions, in addition to the strong striation of the upper head-shields, the figures of the head of *E. erythrosticta* given by Boulenger (Ann. Mus. Genova (2), XII, 1892, pl. i., figs. 2*a* and 2*b*) would answer for our specimen; that one representing the side of the head is particularly an exact reproduction of No. 20078.

Eremias hoehneli, sp. nov.

DIAGNOSIS.—Ventral plates in eight straight longitudinal series; occipital shield present; lower nasal divided, resting on first and second supralabial; supraoculars entirely surrounded by granules; scales on upper surface of tibia much larger than dorsals; upper head shields strongly striated; subocular reaching the lip; posterior chin shields reaching the lip; first pair of infralabials in contact behind the mental.

HABITAT.—Tana River, East Africa.

Type.—U. S. National Museum, No. 20077; W. A. Chanler coll.

Remarks.—This species is very closely allied to *E. brenneri*, with which it shares the strong striation of the upper head shields, the strong carination of the upper scales of the tail, the granules surrounding the supraoculars, and the divided subnasal. It differs, however, in having eight longitudinal series of ventrals, instead of six, in the sub-

ocular reaching the lips, and in the very remarkable scutellation of the lower jaw. *E. brenneri* has five to six elongate, narrow infralabials, none of which are in contact with those on the other side, the last one followed by two or three rows of small hexagonal scales; it has, moreover, four pairs of chin shields, two or three anterior pairs in contact. In our present species, on the other hand, there are only two or three anterior infralabials, the first pair in contact on the median line behind the mental. Thus there are but three pairs of chin shields, only the anterior pair being in contact, while the last pair form the edge of the lip. At the posterior end of the last chin shield there is a long and narrow infralabial, while in the corresponding place in *E. brenneri* there are two rows of small scales.

In addition to these differences the type specimen, the only one collected, shows several divergencies from the only specimen of *E. brenneri* which we have for comparison, viz, the frontoparietal is longer in proportion to its width and is deeply grooved mesially; the two parietals form a straight line behind, while in *E. brenneri* they form a concave angle; gular scales as well as those forming the edge of the collar apparently smaller in the former than in the latter; there is no elongate shield along the outer edge of the parietals. There are probably still other differences between the two specimens, which, however, are somewhat damaged.

In the arrangement of the mandibular shields the specimen upon which I have ventured to base a new species certainly seems somewhat abnormal, and it is possible that the characters adduced from it may prove not to be diagnostic. Nevertheless, the two additional ventral rows and the admission of the subocular to the lip appear of sufficient importance to justify the separation.

I have named the species in honor of Mr. Chanler's traveling companion, Lieut. von Hoehnel, of the Imperial Austrian Navy, who has also done part of the collecting.

Mabuya sechellensis (Dum. & Bibr.).

With 19 specimens from the Seychelles before me, 10 of which were collected by Dr. Abbott, I am unable to recognize *M. wrightii* (Cat. Liz. Br. Mus., III, 1887, p. 162, pl. viii) as a valid species.

From the appended table it is evident that the number of scales round the body varies from 34 to 42, entirely irrespective of the shape of the frontonasal or its relation to the rostral. As to the comparative width and length of the frontonasal, I have only to remark that the difference either way is usually so trifling, and the cases of equality between the two dimensions so frequent, that one is often doubtful as to the location of the specimens. In two cases only, viz, two very large specimens, is the frontonasal completely excluded from the rostral by the supranasals being in contact with each other; in most of the specimens the anterior angle of the frontonasal just touches the rostral, and

only in a few, mostly small specimens, does the frontonasal broadly join the rostral.

List of specimens examined.

U. S. National Museum number.	Whence obtained.	Scales round body.*	Frontonasal longer than broad.		Frontonasal broader than long.	Frontonasal and rostral in contact.	Frontonasal and rostral not in contact.
16718	Abbott	36	—		×	×	—
16719	...do	38	—	×	—	×	—
16720	...do	36	—		×	×	—
16721	...do	34	×		—	×	—
16722	...do	36	—		×	×	—
16726	...do	42	—		×	×	—
16730	...do	42	—		×	×	—
16731	...do	40	—		×	×	—
20456	...do	38	—	×	—	×	—
20457	...do	38	—	×	—	×	—
8281*	Pike	40	—		×	×	—
8282	...do	38	—		×	×	—
20407	Paris Museum	36	—		×	×	—
20408	...do	36	—	×	—	×	—
19222	British Museum	42	—		×	—	×
19223	...do	40	—		×	×	—
19224	...do	40	—		×	—	×
19225	...do	38	—	×	—	×	—
19226	...do	38	—	×	—	×	—

* Frigate Island.

Mabuya chanleri, sp. nov.

DIAGNOSIS.—Lower eyelid with a large, undivided, transparent disk; scales on the soles spinose; the adpressed hind limb reaches beyond the elbow of the adpressed fore limb, but not to the axilla; frontoparietals two; thirty-two scale rows round the body; dorsals feebly tricarinate; subocular not narrowed below; distance from snout to ear-opening greater than from ear-opening to axilla and more than one-half the distance from axilla to groin; color above blackish with large white rounded spots.

HABITAT.—Tana River, East Africa.

Type.—United States National Museum, No. 20104; W. A. Chanler coll.

Description.—Lower eyelid with a medium-sized transparent disk; nostril behind the vertical of the suture between the rostral and the first labial; a small triangular postnasal; anterior loral large, pentagonal, in contact with first and third labials; rostral rather prominent; supranasals not in contact behind the rostral; frontonasal as wide as long, in contact with the frontal; latter equals in length the frontoparietals and interparietal together, in contact with first, second, and third supraoculars; four supraoculars, first comparatively large, second largest, but not much larger than fourth; five supraciliaries, second as large as fifth; frontoparietals distinct, as large as the interparietal; parietals not meeting behind; a pair of narrow nuchals; five supralabials anterior to the subocular, which is not narrowed inferiorly; eight infralabials; ear-opening oval, fully as large as the transparent palpebral disk, with three small obtuse lobules anteriorly;

dorsal and lateral scales very feebly tricarinate; first pair of nuchals entirely smooth; thirty-two scale rows round the middle of the body; the hind limb reaches beyond the elbow of the adpressed fore limb half way to the axilla; scales on the soles sharply keeled, spinose; subdigital lamellæ sharply unicarinate, spinose; tail very slender.

Color of upper side of back, tail, and limbs brownish black, with large rounded whitish spots, each spot usually covering the adjoining portions of three scales, the point of contact between the three scales in the center; the spots are arranged in pretty regular transverse and longitudinal series, about twelve of the former between head and tail, and about ten of the latter, the lower row on each side confluent with the whitish color of the under surface; head lighter brownish, most of the sutures emphasized by darker, with about five more or less interrupted transverse bands of whitish; supralabials as well as sublabials whitish, with broad vertical dark brown bars in continuation of the brown of the top of the head; lower surface whitish, with a few dusky spots on the chin.

Measurements.

[In millimeters.]

Snout to end of interparietal	11.5
Snout to ear-opening	13
Snout to fore limb	21
Snout to anal opening	50
Axilla to groin	23
Fore limb	17
Hind limb	21
Tail (tip broken off)	48

Remarks.—Only one specimen of this well-marked species was sent home by Mr. Chanler, for whom it is named.

Lygosoma kilimensis STEJN.

Proc. U. S. Nat. Mus., XIV (No. 862), 1892, p. 405.

The description of this novelty was based on the specimen collected by Dr. Abbott at the foot of Kilima-Njaro (No. 16749).

Riopa sundevallii (SMITH).

One specimen from the Tana River by Mr. Chanler (No. 20109).

Ablepharus boutonii pœcilopleurus (WIEGM.).

The various subspecies, or forms, by which *A. boutonii* is represented in various localities seems as yet but imperfectly worked out, and the problems concerning its geographical distribution are therefore but imperfectly understood. The material at my command is, however, too scanty to allow me to take the question up in full, but, small as it is, it seems interesting enough to warrant the publication of a few observations.

The specimens before me from the same locality show a remarkable uniformity of color pattern, especially if we consider the great variability of the species. On the other hand, the structural characters—for instance, the relations between frontal and prefrontals, number of scale rows around the body, relative length of limbs, etc.—are subject to great differences in series of specimens from the identical locality.

This will account for my adopting the above name for three specimens from Aldabra Island (Nos. 20473–20475, collected by Dr. Abbott), notwithstanding the fact that they have only 24 scale rows round the body. In coloration, however, they agree perfectly with specimens from the Hawaiian Islands (Nos. 5706 and 12260, U. S. Exploring Expedition) as well as with Wiegmann's colored figure of, *A pœcilopleurus*. from Peru (Nov. Acta Ac. Leop.-Carol., XVII, 1835, pl. viii, fig. 1). They possess the dark lateral band spotted with whitish; a rather well-defined light band above this, and an olive back with black dots which are most numerous in a line bordering the light band.

On Gloriosa Island we find another form which looks entirely different, the status of which will be set forth under the next heading, as I am obliged to give it a new name in order to discuss it intelligently.

Ablepharus gloriosus, subsp. nov.

DIAGNOSIS.—Similar to *A. boutonii*, but with two white and three blackish very distinct and straight-edged lateral bands; four supralabials anterior to the subocular; 20 to 22 scale rows round the body.

HABITAT.—Gloriosa Island.

Type.—U. S. National Museum, No. 20463; Dr. W. L. Abbott coll.

Color description.—Top of head and inner half of the two median dorsal scale rows olive brown; a well-defined brownish black band on either side occupies the outer half of these scales and the inner half of the next scale row, commencing at the outer edge of the supraoculars, the two black bands joining a little back of the anus and continuing as a median dark band down the upper surface of the tail; below this band on either side an equally well defined white band occupies the next two half scales commencing somewhat indistinctly above the nostrils, proceeding backwards over the superciliaries and scales of upper eyelids, whence the band is well defined, and continuing down the tail; below this white band, on either side, another brownish black band occupying on the sides of the body one whole and two half scales, on the neck two whole and two half scales, originating at the nostrils, proceeding backwards through the eye and across the temporal region, and finally continuing down the sides of the tail; the two next half scales are marked with a well-defined white band which involves the supralabials, passes through the ear-opening and above the fore limb, but stops upon meeting the hind limb; finally, below this there is a dusky band, well defined but not of so deep a color as the others, occupying a half and a whole scale row, starting below the

ear-opening, passing through the axilla, and stopping in the groin; limbs above blackish brown with white dots; entire under surface white; palms and soles blackish.

Remarks.—I have given so detailed a color description for the reason that specimens from such a small island may not always be accessible to my brother herpetologists. The description is the more to be relied upon as there are four specimens in the collection, all perfectly alike and all characterized by the same distinctness and straightness of the outlines of the lateral bands.

These specimens are of the same size as those from Aldabra, alongside of which they present a totally different aspect. One of the Gloriosa specimens has only 20 scale rows (No. 20464), the others have 22, while in the three Aldabra specimens there are 24 scale rows. There is, however, another structural difference which seems to me to be of more importance, as I find the nuchal shields of all the four Gloriosa specimens to be wider and with more arched outlines, against the straighter outlines of the same shields in those from Aldabra.

Dr. Boettger (Zool. Anz., 1881, p. 359) has described a specimen from Nossi Bé as variety *A. cognatus*. This specimen also has 22 scales round the body, but only three supralabials in front of the subocular; moreover, and I think this the chief difference from my *A. gloriosus*, it is colored like *A. peronii*, that is, without the lower two bands so characteristic of the former.

Judging from Dr. Peters's remarks (Reise Mossamb., Amph., p. 77), the *Ablepharus* occurring in the Comoro Islands is identical with our Aldabra specimens.

Looking at the map, it can not be denied that the *Ablephari* inhabiting the four islands, or island groups, here mentioned have a rather peculiar distribution, and it will at once be clear how necessary it is to treat these closely allied forms carefully and in detail.

Chamæleo roperi BOUL.

Four specimens (Nos. 16741–16742; 16745–16746) were collected by Dr. Abbott at the foot of Kilima-Njaro, and two by Mr. Chanler on the Tana River (Nos. 20103, 20108).

Chamæleo dilepis LEACH.

Mr. Chanler sends home two specimens from the Tana River (Nos. 20074–20075).

Chamæleo tigris KUHL.

Numerous specimens from the Seychelles by Dr. Abbott. Nos. 16715–16716; 20458. The exact locality of Nos. 20434–20439 is specified as Ile Mahé.

Chamæleo taitensis STEIND.

Three specimens collected by Dr. Abbott at the foot of Kilima-Njaro were described by me, in 1891, as *Ch. abbotti*. Dr. Steindachner's

name, however, seems to have the priority by a few months. I would state, however, that the number of the Wiener Sitzungsberichte containing the description (Math. Nat. Cl., Vol. C., V–VII heft, May—July, 1891) did not reach the library of the Smithsonian Institution until June 30, 1892, while the "Anzeiger" was never received at all.

SERPENTES.

Typhlops schlegelii Bianc.

Two specimens, a large one (U. S. National Museum, No. 20123) and one half-grown (No. 20124) were collected by Mr. Denhardt on the Island of Manda, both alike in all essential points. Color above, dark olive; below, yellow; the outline between the two colors irregular, and the four lowest olive scale rows on each side with a yellow spot in the middle forming four narrow yellow longitudinal lines.

No. 20123 is 430mm long; diameter, 15mm; scale rows, about 36.

No. 20124, 200mm long; diameter, 7mm; scale rows, about 36.

Typhlops mandensis, sp. nov.

Diagnosis.—Nasal large, semidivided, nasal cleft proceeding from the first labial; four supralabials; preocular present, narrower than the nasal or the ocular; no subocular; eye not distinguishable; rostral large; snout not hooked, with obtusely angular horizontal edge; nostrils inferior, just below the edge; prefrontal, frontal, and interparietal of equal size, much larger than the scales on the body; supraoculars and one pair of parietals still larger; diameter of body 23 times in the total length; tail exceedingly short, much wider than long; 34 scale rows round the middle of the body, the median dorsal row not enlarged. Color above, uniform pale greenish gray; below, pale buff.

Total length 135 mm.

Habitat.—Wange, Island of Manda, north of Lamu, East Africa.

Type.—U. S. National Museum, No. 20125; Gustav Denhardt coll.

Remarks.—This new species is apparently nearly related to *T. hallowelli* Jan, which, however, has only 3 supralabials and 28 scales round the body. The scutellation of the head is very much as figured by Sordelli (Jan, Icon. Ophid., livr. 4, 1864, pl. V, fig. 6) except that in *T. hallowelli* the prefrontal, frontal and interparietal decrease in size backwards, the latter being scarcely larger than the scales of the body, while in the present species these three shields are of equal size and much larger than the scales of the body. The supraoculars and parietals are also proportionally larger in the latter.

The only specimen collected has a small abnormal scale on the right side at the junction of the sutures between the preocular and ocular on the one hand, and the second and third supralabials on the other.

Lycognathophis seychellensis (SCHLEGEL).

The Museum possesses 18 specimens of this species from the Seychelles, of which 2 were collected by Col. Pike (No. 8284) and 16 by Dr. Abbott (Nos. 16723–16724; 16732; 20419–20431) the last 13 being from the Island of Mahé.

This large series demonstrates, probably, the extremes of individual variation. It may therefore be useful to enumerate individually the exceptions from the normal scutellation which may be expressed thus: Anal, $\frac{1}{1}$; supralabials, 9; loreal, 0; postoculars, 3; temporals, 1+2.

All the specimens have the normal number of temporals and supralabials (No. 20422 has the sixth supralabial on the left side divided horizontally). The greatest variation is in the number of postoculars, Nos. 20426 and 16723 having only two postoculars on both sides, while No. 20429 has two on one and three on the other. More interesting is the fact that one specimen has an undivided anal (No. 16732), but most so is No. 20419, which has a well-developed loreal on both sides.

The coloration varies greatly, as there are specimens nearly uniformly colored from a light yellowish to nearly black, while others have dark or light spots.

Simocephalus chanleri, sp. nov.

DIAGNOSIS.—Frontal much shorter than the parietals; three postoculars; two labials entering the eye; secondary keels on all the scales, but no oblique striation; dorsal scale row next to the vertebral row not much larger than the laterals; eye much larger than nostril.

HABITAT.—Wange, Island Manda, north of Lamu, East Africa.

Type.—U. S. National Museum, No. 20126; Gustav Denhardt coll.

Description.—Depth of rostral two-thirds the width, visible from above; internasals slightly wider than long, two-thirds the length of the prefrontals; frontal as long as wide, much longer than the prefrontals and much shorter than the parietals; loreal as long as deep; one preocular and three postoculars; temporals 1+2, the anterior large, elongated, and widely separating the fifth supralabial from the parietal; seven supralabials, third and fourth in contact with the eye, seventh very small; five sublabials in contact with the anterior geneials which are considerably larger than the posterior ones; 15 scale rows, all the scales, including the row next to the gastrosteges, strongly keeled, the latter row even showing a secondary keel on each side, while in the adjoining row there are two secondary keels on the lower half of each scale; vertebral scale row with two very strong primary keels, beginning on the fourth scale from the parietals, and two well-marked secondary keels on each side; scales in row next to the gastrosteges largest, the others gradually diminishing in size toward the vertebral row, the one next to the latter but slightly larger than the others; scales in second row from gastrosteges not elongated, scarcely longer than wide; none of the scales with any oblique striation; color above, including

the lateral portion of the gastrosteges, uniform olive gray; below, yellowish. Length of head from tip of snout to end of parietals, 14mm.

The type and only specimen is somewhat damaged, hence the impossibility of giving the number of gastrosteges and urosteges. Anal single.

Remarks.—Boulenger, in the first volume of the new Catalogue of Snakes in the British Museum (1893, pp. 344–347), recognizes five species of *Simocephalus* with which it is necessary to compare the new species. Of these, two are at once easily excluded, *S. capensis* by its very short parietals, and *S. stenophthalmus* by its extremely small eyes. From the other three species the one here described is at once distinguished by its three postoculars.

This, however, is not the only character in which it differs, as will be shown by the following comparison:

The outline of the head of *S. chanleri*, both in profile and seen from above, is most like that of *S. guirali* (See Moquard, Bull. Soc. Philom., (7) XI [on plate erroneously X] 1887, pl. ii, fig. 3), consequently not so flattened and elongated as that of *S. poensis* (see Moquard, tom. cit., pl. i, fig. 2) or *S. nyassæ* (Cat. Snakes Br. Mus. I, 1893, pl. xxiii, fig. 2). The size, form, and sculpture of the dorsal scales of *S. guirali* are entirely different, the comparative smoothness of the extreme lateral row, the elongation of the next one as well as the proportionally greater size of the former and of the one next to the vertebral row being quite characteristic, not to mention the oblique striation of the scales, which is not seen at all in *S. chanleri*. In the latter the prefrontals are also comparatively smaller and the frontal larger.

The island whence came the present species is situated not far from the mouth of the Tana River, and is, I believe, the most northern locality on the east coast of Africa in which any *Simocephalus* has been collected.

Boædon geometricus (SCHLEG).

JAN. Icon. Ophid., livr. 36, pl. iii. fig. 2 (1870).

Boodon seychellensis GÜNTHER, Ann. Mag. Nat. Hist. (6) I, May, 1888, p. 330, pl. xviii, fig. c.

B. geometricus BOULENGER, Ann. Mus. Genova (2) XII, 1892, p. 14.

Dr. Abbott has sent home three specimens from the Seychelles, viz: Nos. 16733, 20446, and 20432, the latter being a comparatively young specimen, collected on the Ile Mahé in 1892. It is somewhat darker, but otherwise colored like the larger specimens, the five dark lines on the back being clearly visible in all. There is a fourth specimen in the museum, collected by Col. Pike on Frigate Island, Seychelles, (No. 8286). All four specimens have 23 scale rows.

Boædon lineatus DUM. & BIBR.

Two specimens from the island of Lamu, collected by Denhardt, a large one (No. 20131) and a young (No. 20130); the former has 27 scale

rows, the latter only 25. A large specimen (No. 16754) from Kilima-Njaro, collected by Dr. Abbott, has 29 scale rows.

Boulenger has recently (Ann. Mus. Genova (2), XII, 1892, pp. 13–15, and Cat. Snakes Br. Mus., I, 1893, pp. 327–336), reviewed the genus and decided that Günther's *B. bipræocularis* is only a synonym of *B. lineatus*, and as he with his abundant material undoubtedly is in a better position to judge, I have named my specimens accordingly, in spite of the fact that all three have two preoculars. I have for comparison only five specimens from Loanda, on the west coast, collected by Mr. Heli Chatelain (U. S. National Museum Nos. 16246; 16249–16251; 20033), and one from Cunga, collected by Brown (No. 16075). All of these have only one preocular; moreover, in all, except No. 16075, the third supralabial has the upper posterior angle produced backward so as to join the eye below the preocular, while in the one from Kilima-Njaro as well as in both the Lamu specimens the third supralabial is excluded from the eye (No. 16075 has it joined on the right side, excluded on the left); finally, in the western specimens there are three longitudinal white stripes on the head, the lower one originating beneath the eye on the fourth and fifth supralabial, while in the eastern ones before me there is no trace of such a stripe.

The young specimen in every respect closely resembles Jan's var. *variegata*, from Mozambique (Icon. Ophid., livr. 36, pl. ii, fig. 4), which also has the same arrangement of the third supralabial, at least a partly divided preocular, and lacks the subocular white streak.

I am strongly of the opinion that it may be possible and profitable to recognize the various subspecies of *B. lineatus*. In such a case the present form would probably stand as *B. lineatus variegatus* (JAN), Günther's *B. præocularis* being a strict synonym of it.

Crotaphopeltis hotamboeia (LAUR.).

JAN, Icon. Ophid., livr. 39, pl. ii, fig. 1.

Five specimens, from Tana River, by Chanler, two adults (Nos. 20110, 20091), two young ones (Nos. 20093, 20094), and one somewhat older (No. 20092).

The old ones are lighter in color, being of a medium brownish gray above, with the top of head lighter brownish and a blackish cloud on the auricular and postauricular region, while the young ones are dark brownish slate, approaching blackish, sprinkled with whitish, but without any marked difference in the color of the head.

I have compared them with three specimens (No. 20806–'8) recently received by the Museum from Mr. J. H. Camp, who collected them at Leopoldville, Congo State, and find them identical.

Philothamnus semivariegatus (SMITH).

Three specimens, two (Nos. 20098 and 20105) from the Tana River, by Chanler, the other (No. 20128) from Island Manda by Denhardt.

Nos. 20128 and 20105 are spotted to the same extent as Peters' figure of his *Ph. punctatus* (Reise Mossamb., Zool. Amph., pl. xix A, fig. 2), while No. 20098 has only a few black spots on the anterior portion of the body.

Hemirhagerrhis kelleri BOETTGER.

Zool. Anz., XVI, April 24, 1893, p. 129.

Two specimens of this species (Nos. 20100, 20112), recently described by Dr. Boettger from Somaliland, were obtained by Mr. Chanler on the Tana River.

Structurally both specimens agree closely with Dr. Boettger's description, allowing for a reasonable individual variation (thus No. 20100 has 2–3 temporals on one side and 2–4 on the other, while No. 20112 has 2–3 on both sides; in the former the preorbitals are somewhat separated from the frontal, while in the latter they barely meet it). In coloration No. 20100 also corresponds well with the Somaliland specimens, but No. 20112 differs in this respect considerably inasmuch as the middle of the back is marked with a broad and very dark brown stripe from the head to within a very short distance of the tip of the tail. This band is four scales wide, occupying the median three rows and one-half scale on each side, the color of these halves being darker, almost black. In addition the other markings above and below are much darker and better defined, the dark vermiculations on top of the head and the outer double line on each side of the gastrosteges being particularly well marked; the two lower whole scale rows in the light space between the median dorsal band and the broad lateral bands are marked with a narrow dusky stripe along the center. The broad median dorsal band is also traceable in the light-colored specimen, especially posteriorly, but it is but slightly darker than the rest of the upper side.

U. S. National Museum number.	Scale rows.	Gastrosteges.	Anal.	Urosteges.	Length of body and head.	Length of tail.
				Pairs	*mm.*	*mm.*
20100	17	?	1/1	75	?	78
20112	17	154	1/1	68	230	64

Hemirhagerrhis hildebrandtii (PETERS).

1878.—*Ablabes hildebrandtii* PETERS, Monatsber. Ak. Wiss. Berlin, 1878, p. 205, pl. ii, fig. 6.—FISCHER, Jahrb. Hamburg. Wiss. Anst., I, 1884, p. 7.

The present species is so rare and the original description so meager that I think it advisable to furnish a detailed description of the specimen at hand.

U. S. National Museum, No. 20106; *Tana River, East Africa; W. A. Chanler coll.*—Nine maxillary teeth, slightly increasing in size backwards, the posterior tooth grooved.

Scale rows 17; gastrosteges 176; anal $\frac{1}{1}$; urosteges 98; supralabials 8, fourth and fifth in contact with eye, seventh largest; infralabials 10, four in contact with anterior chin shield; temporals 2 + 3.

Rostral normal, more than twice as wide as high, quite visible from above; nasal large, much swollen and bent up on the upper surface of the head, the nostril being pierced on the canthus rostralis and quite visible from above, the subnaral suture not reaching the nostril, oblique posteriorly, meeting the suture between first and second supralabials; internasals almost triangular, very small, less than one-third the prefrontals; loreal long and narrow, twice as long as high; a deep furrow from rostral to eye formed by the suture bordering the supralabials above; preocular comparatively small, just touching the frontal above; frontal long, twice as long as broad, longer than prefrontals and internasals together, as long as parietals; supraoculars large, considerably swollen; two postoculars, upper one slightly larger; anterior temporals two, long, the upper one particularly narrow, pointed anteriorly and barely reaching the upper postocular; two pairs of chin shields, the posterior slightly longer. Dorsal scales smooth, with one very distinct apical pore.

Color above drab, with a broad serrated brown band down the middle of the back almost to the tip of the tail, the borders and lateral projections being almost black, the adjoining scales, especially anteriorly, pale buff; a series of blackish spots corresponding to the lateral serræ of the dorsal band on the scale row nearest to the gastrosteges and urosteges; on the posterior half of the body a more or less distinct line on the third row from the grastrosteges and urosteges; tip of tail nearly unicolored buff; top of head drab, with indistinct marblings of dark brown; a dark-brownish transocular streak; each of the labials in both jaws with an ill-defined dark brownish spot; underside whitish, indistinctly marbled with dull rufous and marked with ill-defined, narrow, longitudinal blackish spots; underside of tail densely sprinkled with grayish.

Length of head and body, 250mm.; lenth of tail, 107mm.

Remarks.—This species is evidently rather closely related to Günther's *Coronella nottoœnia* (P. Z. S., 1864, p. 309, pl. xxvi, fig. 1), which should apparently stand as *Hemirhagerrhis nototœnia*. The difference between the two species, as far as it can be made out from the description alone, consists in the number and shape of the anterior temporals and the greater length of the tail in the present species. The coloration appears to be very similar, the chief difference being that the dorsal band in the present species is serrated all the way and the presence in this species of the spots on the scale row next to the gastrosteges. Many other differences might be pointed out were we to accept the details of the scutellation of the head as shown in the figure as absolutely correct in every instance, but that is hardly to be expected.

From *Hemirhagerrhis kelleri*, the type of the genus, the present

species differs somewhat in the dentition, it having nine supramaxillary teeth instead of five. They are somewhat smaller and more closely set, but this would scarcely justify their generic separation, inasmuch as all the other characteristics of the genus are present, particularly the single, swollen nasal with the incomplete, oblique subnaral suture. The coloration is also of a very similar character.

At first I had determined upon a new name for the present species, not supposing that an opistoglyph snake had been described by Peters as an *Ablabes;* but a comparison with his figure and description leaves but little doubt but that it is the same species, and that Peters overlooked the groove of the last maxillary tooth.

Since writing the above I find that Boulenger has recently united *H. nototænia* and *H. hildebrandtii* under the name of *Amphiophis nototænia* (Proc. Zool. Soc. Lond., 1891, p. 307). For the reasons given above I still retain the two names distinct. As to the propriety of uniting *Hemirhagerrhis* Boettger with *Amphiophis* Smith, I can have no opinion, since I am unacquainted with the type species of the latter.

Psammophis sibilans (LIN.).

Jan, Icon. Ophid., livr. 34, pl. iii, fig. 3.

Two adult specimens, one (No. 20129) from Wange, by Denhardt, the other from the Tana, by Chanler (No. 20099).

Psammophis biseriatus PETERS.

Sitzungsber. Naturf. Fr. Berlin, 1881, p. 88.

I have no doubt that the two specimens (U.S. Nat. Mus. No. 20095 *ad.*, 20096 *jun.*) collected by Mr. Chanler on the Tana River belong to this species in spite of some differences from the description of the single type specimen (Mus. Berol, No. 9394) collected by Hildebrandt at Taita.

The chief differences consist in the single anal, as described by Peters, against double in both our specimens, and in the somewhat greater number of urosteges in the type. The latter difference, however, is easily within the range of individual variation, and the difference in the anal seems hardly to be of much greater importance in this instance, inasmuch as the specimens in all other respects seem to agree perfectly. There is the less room for doubt, as both Boulenger and Boettger record the species from Somaliland (Ann. Mus. Genova (2) XII, 1892, p. 15.; Zool. Anz., 1893, p. 119), our locality, consequently, being intermediate.

The chief characteristics of the species, viz, the very elongated head and the great length of the frontal as compared with the supraoculars, the former, consequently, being broadly in contact with the preocular and the prefrontals widely separated from the supraoculars, are very strongly marked in our specimens, and Peters' description of the coloration agrees very well with the larger one. Peters does not at all describe the coloration of the head, which is very characteristic, how-

ever, but as the markings on top of the head are less distinct in the larger of our specimens than in the smaller one, it is possible that they disappear by increasing age. The sides of the head in both specimens are equally strongly marked, as follows: Labials pure white, with a few minute black specks near the commissure and a well-defined black line along the upper edge of the supralabials, bordering below a chestnut-brown transocular band, and no light marks on preocular or postoculars. Top of head grayish brown, with several well-defined light clay-colored marks, narrowly outlined in black in the young specimen; thus the posterior half and the anterior lateral corners of the frontal are marked in this manner, joining behind a curved line occupying the exterior and posterior border of the supralabials; a ω-shaped figure crosses the parietals, while a narrower and fainter line joins the frontal with the rostral covering the internasal and the prefrontal sutures.

The young specimen differs from the old one in the coloration of the back, the ground color being more ashy and the markings more ferruginous. The median scale row is of the latter color, forming a narrow line down the entire length of the back, the inner corners of the lateral spots almost touching it and the outer edges of these in turn connected with a similar line on the fourth outer scale row; each of the outer three scale rows are also marked with a darker brown line; the lateral lines appear to break up into spots on the posterior third of the body and to disappear entirely on the tail.

Of minor differences between Peters' description of the type and our specimens may be mentioned that in these the loreal is perceptibly longer than the nasals together.

Both our specimens have nine supralabials, fifth and sixth in contact with the eye; the younger specimen has 2+3+3 temporals, the older one 1+2+2, but the upper ones are large and plainly the result of the fusion of two plates; the second pair of geneials are very elongate in both specimens, exceedingly so in the larger one.

U. S. National Museum number.	Scale rows.	Gastrosteges.	Anal.	Urosteges.	Length of body and head.	Length of tail.
				Pairs	*mm.*	*mm.*
20095	15	143	1/1	120	420	280
20096	15	* 155	1/1	102	220	165

* About.

Our specimens agree, as it will be seen, perfectly with the one collected at Arusha, at the base of Kilima-Njaro, by Dr. G. A. Fischer, and described, as well as figured, by Dr. J. G. Fischer (Jahrb. Hamburg. Wiss. Anst., I, 1884, p. 13, pl. i, fig. 4), which has 144 gastrosteges, $\frac{1}{1}$ anal, and 109 urosteges. This specimen seems to be somewhat larger than our largest, and the top of the head appears to be uniformly colored as the type; the spots on the labials are larger than in ours.

Thelotornis kirtlandii (HALLOW.).

One specimen (No. 20097) from the Tana River.

Rhamphiophis rostratus (PETERS).

An adult specimen (No 20111) from the Tana River, by Chanler. The specimen shows on the right side of the face the abnormality of having the upper posterior angle of the fifth supralabial separated as a large subocular.

Dasypeltis palmarum?

U. S. National Museum, No. 16755; Kilima-Njaro; Dr. W. L. Abbott coll.

Dasypeltis abyssina?

U. S. National Museum, No. 16756; Kilima-Njaro; Dr. W. L. Abbott coll.

There is such a confusion in the literature concerning the species of the genus *Dasypeltis*, and the specimens before me agree so little among themselves and with the published descriptions, representing about half a dozen species or subspecies, that I have been unable to name them to my own satisfaction. I have therefore selected the names belonging to descriptions which come the nearest to them, adding a query to each. The only other course would have been to make new names, but as I have no doubt that some of the old names will be found available as soon as some one with more material shall have been able to untangle the present skein. But I will ask as a favor of my fellow herpetologists that, if they ever quote the names heading these remarks, they will kindly not omit the question marks which I have added.

No. 16775 is much the larger of the two specimens before me; it is of a uniform dark brownish olive above and yellowish beneath; it has 23 scale rows. This would make it easily *D. palmarum* (Günther, Cat. Col. Sn. Br. Mus., p. 142).* In addition, it has 3+4+5 temporals, the first row scarcely longer than the others, second and third rows keeled. The denticulation of the keels of the third, fourth, fifth, and sixth lower lateral scale rows is very pronounced, the scales themselves being very small and placed obliquely. The supralabials are quite high, the fifth, for instance, being considerably higher than wide. The parietals are very small, being only as long as the frontal.

The other specimen (No. 16756) is much smaller; in fact, quite young. The ground color is the same dark brownish olive, perhaps a shade more brown, and at first sight it appears to be uniform, but upon a closer inspection it is found that there is a series of darker spots on the back separated by a pale space, the markings closely resembling those on the back of Sordelli's figure of *R. scaber* (Jan, Icon. Ophid.,

*Leaving out of consideration the *Rachiodon inornatus* described by Duméril and Bibron (Erp. Gen., VII, p. 498) having 25 scale rows and "la carène des écailles du bas des flancs . . très-forte . . mais à peine dentelée."

39 livr., pl. ii, fig. 4,*) which Peters refers to his *D. scabra* var. *medici*. Even the markings on the neck and head seem to be identical. Were these the only distinctions I should unhesitatingly regard the specimen as the young of the one here called *D. palmarum?*, and the var. *medici* as a synonym, but the scutellation of the head of the young specimen is so radically different from the old one, and from Sordelli's figure as well, that I must regard them as two distinct species until it be proven that the individual variation in these snakes is almost unlimited, and that there is only one species of *Dasypeltis*. The specimen in question has 25 scale rows, the keels of the lateral rows well denticulated. The head, as compared with No. 16755, differs as follows: The supraoculars are more arched, as described by Duméril and Bibron in case of *D. abyssina*; the temporals are 2+4+5, the two first ones being excessively long and smooth, the others small, carinated; the supralabials are very low, the fifth, for instance, being wider than high; the sixth supralabial is extraordinarily developed, the upper border being elongated obliquely backwards along the lower first temporal and parallel with the latter; the seventh supralabial is also quite elongated and partly below the sixth; the parietals are long, being as long as frontal and prefrontals together. I may add that both sides of the head are identical.

It will be observed that the large uniformly colored specimen (No. 16755) as regards cephalic scutellation agrees closely with Sordelli's figure, quoted above, while the young and spotted specimen (No. 16756) in nearly every respect agrees with Duméril and Bibron's *D. abyssina*, both as described (Erp. Gen., VII, pp. 496–497) and figured (Atlas, pl. lxxxi, fig. 2) by them, the chief difference consisting in the lighter and yellower ground color of the latter. It is difficult to see in which other respect Peters' *D. scabra* var. *mossambica* (Reise Mossamb., Zool., III, 1882, p. 120) differs from Duméril and Bibron's species, and it would even appear that Peters' *D. lineolata* (Monatsber. Ak. Wiss. Berlin, 1878, p. 206) only differs in coloration.

In view of the above facts I am inclined to think that all through eastern Africa there occur two well defined species of *Dasypeltis*, (1) *D. palmarum* (possibly only a color variety of true *D. scabra*) having 23 to 25 scale rows; 3 short anterior temporals; parietals not longer than frontal; and (2) *D. abyssina* (with several color varieties, *mossambica*, *lineolata*) having 25 to 27 scale rows; 2 very elongate anterior temporals; parietals as long as frontal and prefrontals together.

Naja nigricollis Reinh.

A young specimen (No. 20090) from the Tana River, by Chanler.

The scutellation of the head is perfectly normal, except that on the right side there are four postoculars, the lower one having been divided, and that on the left side a small portion of the fifth supralabial is divided off forming an additional minute supralabial.

* Probably the type of Bianconi's *Dipsas medici* from Mozambique; see p. 2 of cover of *livr*. 29.

The scale rows on the middle of the body number 25.

The coloration above is pale drab, the margins of the scales being paler, the underside uniform pale buff; round the neck a single broad bluish black collar covering 12 gastrosteges and about as many scales on the vertebral line, starting on the fifth gastrostege and on the sixth vertebral scale from the parietal. A spot of similar bluish black below the eye, but not reaching the commissure.

Atractaspis rostrata GÜNTHER.

One specimen (No. 20127) from Wange, Island Manda, collected by G. Denhardt; 23 scale rows.

Causus rhombeatus (LICHT.).

Two specimens (U. S. Nat. Mus., Nos. 16757, 16758) collected by Dr. Abbott at Kilima-Njaro, in poor condition. They have 19 scale rows; normal rostral; internasal broadly in contact with loreal; large dark, white-margined spots on the back. For these reasons I refer the species to *C. rhombeatus*, of which I have no authentic South African specimen at hand for comparison; but Abbott's specimens agree well with the type of Hallowell's *C. maculatus*, except that in the latter the rhombs are more distant, and the angle of the black cephalic chevron more acute. It will be observed that Peters has already recorded the species from Taita (Monatsber. Ak. Wiss. Berlin, 1878, p. 207).

Causus nasalis, sp. nov.

DIAGNOSIS.—Nineteen scale rows; rostral produced, but forming no ridge above; internasal not in contact with loreal, being excluded by the prefrontal which is in contact with the posterior nasal; anal single; back with narrow, more or less distinct chevron cross-bands having the angle turned backwards.

HABITAT.—Tropical Africa.

Type.—U. S. National Museum, No. 16055, ♂; West Africa; W. H. Brown coll.

Remarks.—In the form of the rostral the present species seems to be somewhat intermediate between *Causus rhombeatus* and *C. resimus* (both species with 19 scale rows), it being more pointed and prominent than in the former, though not to the same extent as in the latter, which is described and figured (Monatsber. Ak. Wiss. Berlin, 1862, p. 277, pl., fig. 4) as having "das Rostralschild vorspringend mit aufgestülpter Krempe." From both of these, however, it differs in the relation of the internasal to the loreal, the posterior outer corner of the former bending down behind the posterior nasal in the two old species, while in the present one it is considerably shorter and not meeting the loreal at all. The cross-bands on the back of *C. nasalis* show a style of pattern entirely different from that of *C. rhombeatus*. The type of *C. resimus* appears to have been uniform on the back, but it is possible that young speci-

mens may show a coloration more approaching *C. nasalis* than *C. rhombeatus*.

Causus rostratus GÜNTHER (P. Z. S., 1864, p. 115, pl. XV) is a species marked like *C. rhombeatus*, but with the rostral of *C. resimus*. Judging from the illustration quoted, the internasal is broadly in contact with the loreal, as in both of these species, and differs consequently in the same manner as they from *C. nasalis*. It has, moreover, only 17 scale rows. In view of these facts I am unable to regard *C. rostratus* as a synonym of *C. resimus*, as du Bocage has been doing (Jorn. Sc. Lisboa, VIII, No. 32, Mch. 1882, p. 290).

Causus lichtensteini JAN (a specimen of which is in the Museum, No. 20805, collected by Mr. J. A. Camp at Leopoldville, Congo State), differs in so many points that a comparison may be considered unnecessary; it has 15 scale rows and a blunt rostral, even less prominent than that of *C. rhombeatus*. On the other hand, the coloration is somewhat similar to that of *C. nasalis*, and the internasal is widely separated from the loreal. The above characters are more than sufficient to separate them.

Causus jacksonii GÜNTHER is the latest species described (Ann. Mag. Nat. Hist., (6) I, May 1888, p. 331), and in many respects the one which comes nearest to *C. nasalis*. The coloration appears to be very similar as well as the form and size of the rostral. Whether the internasal joins the loreal, or not, is not expressly mentioned in the description, and no figure is given, but it is said that "in other respects [except rostral] the scutellation is very much as in the other two species" [*C. rostratus* and *C. rhombeatus*]. The chief character to be relied on in Dr. Günther's description is therefore the number of scale rows, which is 23, and as he had three specimens before him this alone would seem sufficient.

The exact locality of the type of *Causus nasalis* was not furnished by the collector (Mr. W. H. Brown, of the U. S. Eclipse Expedition to West Africa, 1889). However, a very similar specimen, though larger but in poorer condition, was obtained by him at Cunga on December 25 (U. S. Nat. Mus. No. 16074), and the type is probably from the same neighborhood. This large specimen has lost the arrow-shaped mark on the occiput, as well as the postocular streak, but the dorsal chevrons are well marked. In the type both the cephalic and the dorsal marks are well pronounced.

In addition to these West African specimens we have recently received two specimens collected by Mr. Chanler on the Tana River (U. S. Nat. Mus. Nos. 20088 and 20089), both smaller than the type; No. 20089, in fact, quite young, only 148^{mm} long. In the larger specimen the blackish color markings have nearly disappeared, but they are well developed in the young one, agreeing perfectly with the type in color, though the ground color is more bluish.

In scutellation the eastern specimens differ but very little from the western ones. The internasals and loreals are quite alike. The only

difference which I can detect is that the indication of a keel on the dorsal scales is slightly more pronounced in the eastern ones. The number of scale rows are also somewhat variable in the latter as I have counted 20 rows almost as often as 19. In addition I may say that in the youngest specimen the rostral is but slightly prominent, hardly more so than in *C. rhombeatus*.

U.S. National Museum number.	Collector.	Locality.	Scale rows.	Gastrosteges.	Anal.	Urosteges.	Head and body.	Tail.
							mm.	*mm*
16055	Brown	West Africa	19	143	1	$\frac{21}{21}$	310	30
16074	...do	Cunga, West Africa	19	146	1	$\frac{11}{17}$	495	42
20088	Chanler	Tana River, E. Africa	19 (20)	134	1	$\frac{35}{32}$	270	32
20089	...do	...do	19 (20)	145	1	$\frac{22}{22}$	140	8

II. BATRACHIA.

ECAUDATA.

Phrynomantis bifasciata (SMITH).

Three specimens (U. S. National Museum, Nos. 20113–20115) collected by Chanler at the Tana River. They belong to Boulenger's variety A (Cat. Batr. Sal. Br. Mus., p. 173) with the modification that the lateral bands do not commence on the upper eyelids but between the nostrils. It is to be noted that Dr. G. A. Fischer has already collected this species at Wito on the Tana (Peters, Reise Mossamb., Zool., Amph., p. 172).

Bufo regularis REUSS.

Eight specimens (U. S. National Museum, Nos. 20107, 20116–20122) collected by Mr. Chanler on the Tana River, and two (Nos. 16751–16752) by Dr. Abbott at Kilima-Njaro.

In all the specimens the vertical light line above the shoulder is plainly indicated, no matter how different the coloration may otherwise be. All are likewise marked with dark rose-color on the posterior aspect of the thighs, while in some of the younger individuals the rose-color also pervades the back in a varying degree. In the young specimens the tympanum is comparatively smaller than in the adults; but the first finger is in all distinctly longer than the second.

Hyperolius cinctiventris COPE.

The only specimen sent home by Mr. Chanler, who collected it on the Tana River (U. S. National Museum, No. 20493), belongs undoubtedly to the species collectively named as above, but I am not by any means convinced that all the names referred to by Boulenger (Cat. Batr. Sal, Br. Mus., 1882, p. 126) under the present species are in reality unconditional synonyms.

For that reason it may be useful to make a few notes concerning structure and coloration of Mr. Chanler's specimens,

In the first place the rudiments of webs between the fingers are very minute; the temporo-crural fold as well as the gular fold and the one surrounding the ventral disk strongly marked; skin on the disk as well as on the space between the lateral folds coarsely granular, skin on throat and underside of thighs more finely so.

Color above (in alcohol) very light drab with minute brownish spots on lower back; a well-defined arrow-shaped brownish gray mark between eyes, the point turned backwards and a short shaft-like projection from the anterior margin; a similarly colored band from nostril through eye obliquely down to corner of mouth; lips white, with an indistinct broad brownish band from eye to lip; a dusky line across the wrist and a similar one across the middle of the forearm, the space between being perceptibly lighter than the ground color; lower half of tibiæ apparently similarly marked; lower surface of limbs, breast between the gular fold and the anterior border of the ventral fold, as well as space between the lateral border of the latter and the temporo-crural fold, cinnamon-colored.

Phrynobatrachus acridoides (Cope).

Two specimens (U. S. National Museum, Nos. 20101–20102), collected by Mr. Chanler on the Tana River, agree in all essential points with Cope's original description (Journ. Acad. Phila., VI, 1867, p. 198) of *Staurois acridoides*. In addition to the characteristic dorsal plicæ our specimens have another descending from beneath the well-pronounced tympanum to the humerus. The coloration is also as described, though our specimens have no vertebral band, but there is a large blackish, pale-margined, triangular patch across the top of the head to the outer edge of the eyelids, the apex of the triangle pointing backwards; the tympanum is covered with a dark patch and the upper lip is dark with minute white dots.

Rana mascareniensis Dum. & Bibr.

Five specimens (U. S. National Museum, Nos. 16734–16738) from the Seychelles by Dr. Abbott. In all the specimens the fifth toe is longer than the third, or exceptionally equal to it, but never shorter. No. 16735 is a male with the external slits of the vocal vescicles parallel with the commissure and situated directly under the tympanum.

APODA.

Hypogeophis rostratus (Cuv.).

Six well-preserved specimens, five adult and one young (U. S. National Museum, Nos. 20440–20445), collected by Dr. Abbott in the Seychelles, and one half-grown specimen received from the Paris Museum (No. 20403), throw considerable light on the individual variation of the present species and the validity of the characters assigned to it.

They show, among other things, that the relative number of complete and incomplete "circular folds" relied upon by Boulenger in constructing his key to the species of this genus (Cat. Bat. Grad. Br. Mus., 1882, p. 96) is of no value. It is plain from the appended table that while in some of the specimens "nearly all the circular folds* completely surround the body," in others the majority of these folds are widely separated on the anterior portion of the back, a few nearest to the head being complete, however, in most cases. On the ventral surface all the rings counted are continuous, the lateral impressions on the posterior portion, which were not counted, alternating with the complete rings. It seems, therefore, better to rely upon the smaller number of rings and their incompleteness on the anterior portion of the ventral surface in separating *H. guentheri*† from *H. rostratus.*

List of specimens.

U. S. National Museum number.	Portion of back.	Number of complete rings.	Number of incomplete rings.	Total number of rings.
20440	Anterior	10		106
	Middle		63	
	Posterior	33		
20444	Anterior	12		106
	Middle		74	
	Posterior	20		
20445	Anterior	17		106
	Middle		54	
	Posterior	35		
20442	Anterior		74	111
	Posterior	37		
20441	Entire	107		107
20443	Entire	105		105
20403	Entire	109		109

Hypogeophis alternans, sp. nov.

DIAGNOSIS.—About 163 to 175 folds, the posterior 40 to 50 complete on the ventral and dorsal lines; the posterior 79 to 86 complete across the dorsal surface as well, while anterior to these, above and below, the complete primary rings alternate with secondary rings broadly interrupted on the dorsal and ventral lines; snout shorter than width of head across the eyes; tentacle halfway between and below eye and nostril.

HABITAT.—Seychelle Islands.

Type.—U. S. National Museum, No. 20418; Mahé, Seychelles; Dr. W. L. Abbott coll.

* As "circular folds" I have only counted those which are visible on the upper and lower surfaces, whether interrupted on the middle of the back and belly or not. I have consequently left out those short impressions on the posterior half of the body which are only visible if counting along the sides and which can not by any stretch of language be termed "circular." As a result I count 105 to 111 circular folds against Boulenger's "about 125."

† Judging from the number of rings and their completeness on the back of the full-length figure on plate vii (Cat. Bat. Grad. Br. Mus., 1882) it represents *H. rostratus* rather than *H. guentheri*, although so designated.

Description of type specimen.—Teeth small, subequal in each jaw, the mandibulars larger than the maxillaries, the palatines very small; number of teeth on one side: Maxillary, about 30; mandibulars, outer row, about 25, inner row, 5; snout rounded, prominent, shorter than width of head across the eyes; eyes very indistinct; tentacle near the border of the lips equidistant from eye and nostril; body depressed, with a shallow longitudinal groove on each side of the back and one along the ventral median line; 175 folds, of which the posterior 40 are continuous across both the dorsal and the ventral lines, while the posterior 86 are also continuous on the dorsal line; anterior to the 40 below and the 86 above complete primary rings alternate with incomplete folds, the latter decreasing in length toward the head, though clearly traceable to within one ring from the latter; tail somewhat conical, indistinct. Purplish-black above and below, anterior portion of head dark yellowish gray.

Total length, 315 mm.; greatest diameter of body, 16 mm.; snout, 6.5 mm.; width of head across the eyes, 8.5 mm.

Remarks.—In general coloration the present species, of which we possess the large type specimen collected by Dr. Abbott and a half-grown one received from Prof. Léon Vaillant (No. 20404; Seychelles), agrees very closely with our specimens of *H. rostratus*, but it is at once distinguishable from the latter by the different arrangement and number of the folds, the greater width of the head, shorter snout, and different position of the tentacle, which in the latter is much nearer to the nostril.

On the other hand, the new species shows considerable similarity in the arrangement of the folds to Boulenger's *Cryptopsophis multiplicatus*, which also hails from the Seychelles. The latter represents a different genus, however, lacking the interior row of mandibular teeth, while our specimen has five well-developed inner mandibulars on each side. The position of the tentacle is also widely different it being three times nearer the eye than the nostril in *C. multiplicatus*.

As the arrangement of the folds also resembles somewhat that of *Uræotyphlus oxyurus*, I was at first inclined to refer Duméril's two small specimens from the Seychelles, and recorded by him as belonging to the latter species (Mém. Soc. Sc. Nat. Cherbourg, IX, 1863, p. 316, pl. i, fig. 8), to the species here described by me. In looking at the figure (*l. c.*) I find, however, that the tentacle is placed directly under the nostril, and I am consequently forced to believe that there is still another cæcilian found in the Seychelles in which the tentacle is thus located, though its identity with the true Indian *U. oxyurus* appears rather doubtful.

In regard to the generic position of the new species I have to remark that the tentacle appears to be surrounded entirely by a groove, but as it presents the same appearance as in several of the specimens of *H. rostratus*, in which I have been unable to make out its flap-like nature,

I have concluded that this is due to shrinking of the alcoholic specimens. The squamosals are in contact with the parietals.

The young specimen is in less satisfactory state of preservation, but the characteristic points are readily made out and the differences in the folds between the two specimens are expressed in the diagnosis.

NOTES ON RECENT COLLECTIONS OF NORTH AMERICAN LAND, FRESH WATER, AND MARINE SHELLS RECEIVED FROM THE U. S. DEPARTMENT OF AGRICULTURE.

BY

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Adjunct Curator of the Department of Mollusks.

The following species, received during the year 1892 from the Department of Agriculture, represent the Molluscan portion of the collections made during said year by Dr. C. Hart Merriam and his assistants, in the Division of Biological Explorations.

As in previous accessions from the above source, many interesting facts pertaining to the geographical distribution of the forms collected, give additional value to the material obtained, and furnish many items of importance relating to the local faunæ of various parts of the country.

Following the terrestrial species which constitute the principal part of the collection, a few fresh-water species are listed, closing with several marine forms from the Gulf border of the State of Mississippi.

Class GASTROPODA.

PULMONATA-GEOPHILA.

Family TESTACELLIDÆ.

Genus **GLANDINA** Schumacher.

Glandina truncata Gmelin.

One or two examples from each of the following localities:

Chattahoochee, Fla.; Houma, La.; Washington, Miss.; Riceboro, Liberty County, Ga.; Vernon Bailey, April, 1892. Mr. R. J. Thompson also obtained two examples of this species at the last-named place at about the same time. The Georgia specimens were found on the Le Conte plantation.

This is a widely distributed species and probably the most familiar form of the genus. It is found in the "Atlantic and Gulf States, from North Carolina to Texas, as far north as Macon in Georgia, Bibb County, Ala., and Jackson, Miss." I found it quite numerous among the grass in moist, springy ground just outside the military reservation of Fort Brooke, at Tampa City, Fla., in 1869. My collection included the typical form as well as the varieties, *parallela*, etc.

Family LIMACIDÆ.

Genus ZONITES Montfort.

Zonites lævigatus Pfeiffer.

Three examples.

Washington, Miss., "in the woods," Vernon Bailey, May, 1892. Binney, in his useful "Manual of American Land Shells," says of this species, "I have received specimens from Pennsylvania to Arkansas, from Illinois to St. Augustine, Fla., and Mobile. It attains its greatest development in the Cumberland subregion."

Family PHILOMYCIDÆ.

Genus TEBENNOPHORUS Binney.

Tebennophorus carolinensis Bosc.

One specimen.

Stone County, Mo., near Marble Cave; Vernon Bailey.

This large and distinctly characterized slug occurs as far north as "Canada, and as far to the south as Texas and Florida." (Binney.)

I have collected numerous examples among the bricks, ruins of an old building near the historic Burns residence at the foot of Seventeenth street, Washington, and it is apparently quite common at many places in the District of Columbia, and presumably in the surrounding country.

Family HELICIDÆ.

Genus PATULA Held.

Section ANGUISPIRA Morse.

Helix (Patula) alternata Say.

One dead specimen.

Washington, Miss., Vernon Bailey.

The solitary example obtained here was not quite mature. The variation exhibited by this species makes it an exceedingly interesting form to the student. While limited in this respect when compared with the protean *strigosa*, nevertheless it includes *cumberlandiana*, *Fergusoni*, and *mordax*, as heretofore indicated,* and as proven by the ample series in the National Museum, which exhibits a direct gradation of intermediate and blending varieties. Mr. Pilsbry† in this connection speaks of "*alternata*, including also *mordax* and *cumberlandiana* (which are hardly more than extreme forms of *alternata*)," etc.

"This pretty and variable species ranges from Labrador to Texas throughout the eastern United States, and is found in the postpliocene of the Mississippi Valley, retaining some of the color of the red flame-like patches." (Binney.)

* Proc. U. S. Nat. Museum, vol. XIV, 1891, p. 96.

† Manual of Conchology, vol. VIII. p. 115.

Helix (Patula) Hemphilli Newcomb.

=*H.* (*Patula*) *strigosa* Gould var.

Five examples, dead.

Fort Huachuca, Ariz., at an elevation of about 4,300 feet above the sea; Dr. A. K. Fisher, May 14, 1892. (Mus. No. 125,599.)

The specimens of the above, collected by Dr. Fisher, exceed in size any of the numerous examples of the *Hemphilli* variety of *strigosa* that I have seen. In other respects, too, they are of interest, as they exemplify within a small number of individuals a range of differentiation from the subangulate to the keeled or angulate whorls. They are all more or less flattened and carinate, for extreme as the typical *Hemphilli* is when compared with the typical *strigosa*, it is nevertheless connected by a chain of intermediate and gradually connecting forms. In some of Dr. Fisher's specimens, a supersutural groove follows the whorls, and one nearly fresh example shows two color-bands, one above and one below the periphery. It is to be regretted that Dr. Fisher did not obtain more, and living examples of this interesting form from the Arizona region.

Bailey collected this form in August, 1890, "among rocks at an altitude varying from 8,000 to 11,000 feet," on the slopes of Needle Peak, Lost River Mountains, Idaho. The variety *Hemphilli* had previously been obtained in Idaho by Hemphill, and has heretofore been reported from Nevada, Utah, and Colorado.

In the May, 1892, number of "The Nautilus," I published the fact of the detection of *Patula strigosa* (Mus. No. 123,576), by Mr. Marcus Baker, of the U. S. Geological Survey, at Coon Mountain, Ariz., about 10 miles south of Canyon Diablo. Mr. Baker's specimens were found "scattered along the interior slopes of the crater;" they are mostly dead shells. The elevation, as stated, is between 5,200 and 5,700 feet above tide level. The whole region is excessively arid, and the general aspect of the shells collected by Mr. Baker implies an environment of that kind. As a whole they are rather flat than elevated, and more or less angulated at the periphery. The fresher examples are slightly rufous, with two narrow revolving bands on the body whorl. The character of the locality partially described by Mr. Baker will be still better understood by the following abstract of a paper read before the National Geographic Society of Washington, D. C., by Mr. G. K. Gilbert, in March, 1892, and it will further give a pretty fair idea of the general character of the environment elsewhere, where this remarkable species and its varieties are the prevailing forms.

From Mr. Gilbert's paper, it appears that Coon Mountain is a curiously shaped crater in a desolate region some three days journey from Flagstaff. The crater is about three quarters of a mile in diameter, bowl shaped and quite deep, and various reasons have been given at times for its existence. Near it have been discovered so many specimens of meteoric iron, that it would seem almost necessarily more than a mere coincidence. Speaking of the unequal distribution of land and water on the surface of the earth, Mr. Gilbert said that one reason given in explanation of that

was that there was a greater density in that hemisphere and hence a greater attracting power for water. This unequal density might be accounted for by some unusual accretion there, such as would arise from contact with a star. Speculation as to the possibility that the earth's greater hollows originated in this way suggested to him a similar explanation for the origin of the Arizona crater, that it was caused by the collision of an iron star several thousand feet in diameter.

In order to find out what this theory was worth, Mr. Gilbert, accompanied by Mr. Marcus Baker, visited Coon Mountain and camped near there for some time, carefully studying all the peculiarities of the place, and making a number of observations to discover whether the relation between all this meteoric iron and the crater, was one of cause and effect, or of coincidence merely. Coon Mountain rises some 400 feet above the level of the surrounding plain, and the bottom of the crater is about 600 feet below the highest point on the rim.

The rock strata of the plain are limestone and sandstone and lie nearly flat. In the rim of the crater these rocks are bent upward, and upon them lie broken fragments of the same materials. The peculiarity of the crater, from the geological point of view, is that it contains no volcanic rocks, and in this respect is unique. The phenomena observable in connection with the crater had given rise to a number of hypotheses, two of which the speaker discussed more freely than the others. The glacial hypothesis and the theory of the limestone sink are both inadequate. The true hypothesis of the crater implies the expenditure of a tremendous amount of energy in a very brief space of time. By the system of elimination all the hypotheses have been abandoned with the exception of the stellar and the explosive. Magnetic and volumetric tests were applied, and with the former the needle showed no evidence of the presence of a considerable mass of iron. After experiments with these same needles later it was estimated that if the crater was formed by the penetration of such a mass, it must have been buried 50 miles below the surface to have affected the needle so slightly.

By the volumetric test it was necessary to determine whether the débris surrounding the crater would just fill it or exceed the necessary amount by the supposed amount of the embedded star. It was found that it would just fill it, and this would seem to compel the abandoning of the stellar theory, and we are forced to believe that the relation of rock and crater is one of coincidence only, though the chances of such a coincidence are not greater than one in five thousand. After comparing the phenomena of Coon Mountain with those of the volcanic eruptions in Japan in 1888, Mr. Gilbert said that in the future Coon Mountain will probably be looked upon as an example of the bursting of the earth's surface by volcanic steam unaccompanied by lava. It is highly improbable that this catastrophe was witnessed by man.

From a description of the region and the phenomenal character of the remarkable locality where Mr. Baker collected his examples of *strigosa*, we will return to a further consideration of the shells and the varietal aspect they exhibit. In a recently published portion of his Manual in refering to the *strigosa* group of *Patula*, Mr. Pilsbry says:*

In the species of this division [Anguispira], the characters of sculpture, form and color and to a less degree of the soft parts, vary to an extent inconceivable to those who have not actually seen the shells. It may now be demonstrated that the forms described as *H. strigosa, Cooperi, idahoensis, Hemphilli, Haydeni*, etc., are connected by such a multitude of intermediate forms that it is absolutely impossible by the most acute analysis, to draw lines of demarcation between them.

It is refreshing in these days of excessive systemization and species-making to meet with a paragraph like the above by an author of justly recognized ability in a publication of standard character and impor-

* Vol. VIII Manual of Conchology page 115, Feb. 28, 1893.

tance; yet it would not be a matter that need cause surprise to find in the course of twelve months some disciple of the "new school" rushing into print with a "revision" of this peculiar group, in which every third individual shell is honored or dishonored with a generic, subgeneric, or some other title, to say nothing of elaborate, though more general, divisions, subdivisions, etc., *ad libitum*, in frivolous perplexity.

The National Museum contains a magnificent and exhaustive series of *strigosa* and what are now regarded as its varieties, probably surpassing all others excepting that contained in Mr. Hemphill's private collection; it includes not only the ample series received directly and indirectly from Mr. Hemphill, but numerous accessions, large and small, made by various parties, in the course of explorations and travel within the general territory inhabited by *strigosa* and its allies.

Genus **POLYGYRA** Say.

Helix (Polygyra) auriformis Bland.

Ten specimens.

Bay St. Louis, Mississippi; Vernon Bailey, April 30, 1892. "In the pine woods"; examples mostly dead and bleached. The foregoing has been found to inhabit Florida, Alabama, Louisiana, Texas, and the Indian Territory. Numerous beds of semifossil specimens are found in Middle Alabama. (Binney.)

Helix (Polygyra) Dorfeuilliana Lea.

Dead shells.

Stone County, Mo., Vernon Bailey, on side hills near Marble Cave.

This form is widely distributed through many of the Southern States, having been collected in Florida, Louisiana, Texas, Arkansas, Indian Territory, etc., and as far to the north as Kentucky, opposite Cincinnati, Ohio. Mr. McDaniel reports its occurrence in eastern Texas, in Anderson County.

Genus **MESODON** Rafinesque.

Helix (Mesodon) albolabris Say.

One specimen.

Stone County, Mo., near Marble Cave, on sidehills, with the previous species; Vernon Bailey.

This familiar form has a wide geographical distribution. The national collection contains numerous examples, forming an exceedingly fine series, embracing nearly seventy trays.

The geographical range of *albolabris* extends from Maine to Minnesota, inclusive of Canada (at various places), thence southerly to Arkansas, Mississippi, and Florida, and the States and Territories included between the above northerly and southerly lines, comprising, as shown in the collection, a representation of twenty-three of the States, etc.

As would naturally be supposed, of a form inhabiting so great an area, considerable variation is exhibited, and one finds adults in some places with small shells, in others with shells conspicuously large; some with elevated and some with depressed shells. Again, in some localities, the growth lines are delicate, and the shells also light and thin; others have heavy shells, and a coarse sculpture. Another and more striking varietal character is the occasional presence of a toothlike prominence on the parietal wall, and sometimes a toothlike process is seen at the base of columella on the peristome.

The genus *Mesodon* is represented on the Pacific coast of North America by several species. At the present time there is a great gap between the western and northern extension or limit of the group as we trace it *westward* from the Atlantic side of the continent, and the extremest eastern locality, at which it has been found as we follow it *eastward* from the Pacific coast. Regarding, as I do, both *H. Townsendiana* and *H. ptychophora* as *Mesodons*, and considering the latter as a variety of the former, we find these West or Pacific-coast forms extending eastward as far as Idaho, where *ptychophora* has been detected, near Salmon River and in the valleys and on the slopes of the Bitter Root Mountains; it also occurs in Montana, according to Binney. Between western Idaho and Minnesota there is, it will be seen, a great gap, in which we have no evidence of the existence or presence of any form of *Mesodon*. It is not, however, unreasonable to suppose, that sooner or later this long reach will be materially shortened by the detection of *Mesodon* at new localities, both in the easterly and westerly margins of the present boundaries.

From the Miocene of the John Day region,* in the neighborhood designated as the North Fork of the John Day River, Oregon, longitude 119° 40′, latitude 44° 50′, as given by Prof. Condon, we find *Mesodon* associated with *H.* (*Arionta*) *fidelis*, *H.* (*Patula*) *perspectiva* and the rare and curious *Ammonitella Yatesii* of Dr. Cooper.† To the *Mesodon*, which I regarded as an undescribed form, I gave the name of *Dallii*. The other species, from the John Day beds, are familiar to the collector and student of recent land shells, though *Yatesii* is about as rare as *fidelis* is common.

Mesodon Dallii differs from any of the living representatives of the group inhabiting the Pacific States. It suggests an ancestral form, from which may have proceeded the species known as *columbiania*, *devia*, *germana*, etc. *Ammonitella Yatesii* is so exceedingly rare, and

* Bulletin of the U. S. Geological Survey No. 18. On the Marine Eocene, Fresh-water Miocene and other Fossil Mollusca of Western North America, by Chas. A. White, M. D. Washington, 1885.

†This species is generally referred to by authors as *Gonostoma Yatesii*, but Cooper's genus *Ammonitella*, 1868, which is based on this form, is valid and should therefore stand, as Rafinesque's *Gonostoma* (applied to a group of fishes), 1810, has precedence over the use of said name in the Mollusca, (Held., 1837) by twenty-seven years, as well as over Pfeiffer's use of *Gonostoma* in 1879.

is so restricted and peculiar in its distribution, that, considered in connection with the fossil examples, it may be regarded as obsolescent or as an interesting survival of the extraordinary physical changes of the John Day epoch, and the apparent absence of *Mesodon* in the region heretofore indicated, may be due to its absolute obliteration through similar causes during the middle or later tertiary periods as well as to still later physical changes.

Helix (Mesodon) dentifera Binney.

One dead, fresh example.

Washington, Miss.; Vernon Bailey.

Mr. Bailey has carried this form quite far to the South. Its range has heretofore been given as from Maine to North Carolina.

Helix (Mesodon) thyroides Say.

Var. *bucculenta* Gould.

Several examples.

Washington, Miss. (one example living); near Marble Cave, Stone County, Mo. (three specimens), occurring on the sidehills, and at Houma, La. (nine dead specimens); Vernon Bailey.

Mr. Binney says of *thyroides:* "A post-pliocene species now found all over the eastern province. The variation in size is very great. The small or *bucculentus* form of this species is usually that found in the Southern States. Both the larger and smaller forms exhibit a small parietal callosity or tooth, and the shell is also variable in the umbilical feature." Binney credits it to Washington County, Tex., and Mr. W. L. McDaniel, of Tyler, Tex., has collected the *bucculenta* form in Williamson County in that State.

Some examples of *thyroides-bucculenta* that I have inspected are externally very close to occasional individuals of the so-called *ptychophora*, from Cœur d'Alene, Idaho.

Genus **TRIODOPSIS** Rafinesque.

Helix (Triodopsis) inflecta Say.

Two specimens, dead.

Stone County, Mo.; Vernon Bailey, July, 1892.

The above examples were found on the slopes of the hills near Marble Cave. The species inhabits a large territory, extending from the Atlantic seaboard westerly to the valley States of the Ohio and Mississippi rivers, and southwesterly to Texas. A well marked and easily recognized form.

Helix (Triodopsis) Levettei Bland.

Ten examples.

Fort Huachuca, Ariz., Dr. A. K. Fisher, May 14, 1892.

The specimens collected by Dr. Fisher, though much larger than the type, having from one-and-a-half to two-and-a-half more whorls, agree

perfectly in every other respect and also agree with examples in the U. S. National Museum (No. 124481) from Tucson, Ariz., presented by the late Dr. Isaac Lea. The Lea specimens, of which there are several. include examples that exhibit the characteristics of *Triodopsis*, as well as others, in which the peristome is simple or not tridentate or denticulate, in this respect being like other species that have been placed in the above genus, and show upon what an infirm foundation some of these genera are based.

It is quite evident that however persistent the tridentate character may be in certain forms, in others it is variable, and therefore of little value; the latter may be regarded as the connecting links which unite *Triodopsis* to *Mesodon*.

Bland's description* rests upon "two living and one dead specimen," collected by Dr. G. M. Levette, near Santa Fe, N. Mex. Binney, quoting Bland, says; "this species is quite distinct from any known North American or other form. The number of whorls and of teeth, their form and color, with the color of the shell and peristome, are its peculiar features. The striæ are by no means so well developed as shown in the figures."

Further on, he observes: "the species varies in the number of teeth on the peristome. Some have one basal tooth only, which in some specimens is widely and bluntly bifid."

Attention is called to the geographical extension of the range of this species and of *Patula strigosa* var. *Hemphilli;* for this addition to our knowledge we have to thank Dr. Fisher and the Biological Division of the Department of Agriculture.

From the habitat of Dr. Levette's examples to Tucson, the locality of the Lea specimens, and Fort Huachuca, is nearly 400 miles in a southwesterly direction; the latter place is so very near the boundary line between the state of Sonora, Mexico, and the United States, that there can be hardly a doubt that further exploration of the general region will detect both *H.* (*Patula*) *Hemphilli* and *H.* (*Triodopsis*) *Levettei* south of the boundary, and add their names to the list of the Mexican fauna.

Genus **ARIONTA** Leach.

Section LYSINOE H. and A. Adams.

Helix (**Arionta**) **californiensis** Lea.

One specimen, dead.

Monterey, Cal., "in the woods," October 8, 1891; Vernon Bailey.

A familiar form, which seems to have its specific center in this region. I collected a large number of the above at this place in March, 1867, in openings on grassy slopes.

* Binney's Manual of Am. Land Shells (Bull. 28, U. S. Nat. Mus.), p. 385, 386, fig. 419.

Helix (Arionta) Dupetithouarsii Deshayes.

Two examples, dead.

Monterey, Cal., with the foregoing, on the same day; Vernon Bailey. This species is rather local in its occurrence; the Santa Cruz form, somewhat differentiated in color and epidermis, though modified environmental conditions, has received the name of *sequoicola*.

Helix (Arionta) Rowelli Newcomb.

=*H. Lohri* Gabb.

Three specimens, dead.

Fort Huachuca, Ariz.; Dr. A. K. Fisher, May 14, 1892.

Dr. Fisher's examples agree perfectly with the specimens in the National Collection, collected by the late Prof. Gabb, who found them, as elsewhere stated by me, in the table-lands of Lower California, near Mulege. It has been reported from the Salt River Mountains, 7 miles north of Phœnix, Ariz., by Pilsbry, and has been credited to Chihuahua, Mexico, and still further to the eastward in the State of Texas.

It is interesting to note its occurrence at Fort Huachuca, associated with *Patula Hemphilli* and *Triodopsis Levettei*.

Binney, on page 22 of the Manual of American Land Shells, in speaking of *H. Rowelli*, says it "has been referred to Arizona, but erroneously," and, in connection with *H. Remondi (Carpenteri)*, says "it is the only species common to the peninsula and mainland of Mexico;" these statements, in the light of later knowledge, require correction. It is highly probable that other forms now regarded as peculiar to the peninsula of Lower California, will sooner or later be detected on the mainland.

Family BULIMULIDÆ.

Genus **BULIMULUS** Leach.

Bulimulus dealbatus Say.

Four dead shells.

Stone County, Mo., near Marble Cave, "on the side hills;" Vernon, Bailey.

The upper whorls of the adults exhibit the longitudinal ribbing characteristic of *B. Ragsdalei* Pilsbry. This species has heretofore been reported from various places in Texas by Mr. Bailey and others connected with the Biological Division of the Department of Agriculture.

William Lloyd collected several examples of this species at Monterey, Mexico, in 1891.

Family SUCCINIDÆ.

Genus **SUCCINEA** Draparnaud.

Succinea Salleana Pfeiffer.

Six examples, dead.

Houma, La., Vernon Bailey, May 8, 1892.

This is a well-marked species and quite distinct from the following:

Succinea concordialis Gould.

Six specimens.

Houma, La.; Vernon Bailey.

This also is a well-defined and characteristic form, easily separable from the preceding species, and has heretofore been credited to "Lake Concordia, in Texas."

PULMONATA-HYGROPHILA.

Family LIMNÆIDÆ.

Genus **PLANORBIS** Guettard.

Planorbis tumidus Pfeiffer.

Numerous bleached specimens.

Pan Handle, Tex., August 25, 1892; Vernon Bailey.

The shells of this species were "found in a dry basin on the prairie, at an altitude of 3,660 feet above sea level." This form also occurs in Nicaragua.

Planorbis trivolvis Say.

Ten examples.

Houma, La.; Vernon Bailey, May, 1892.

These shells are partly juniors, but the lot contained a sufficient number of perfect adults to admit of identification. A common form found nearly everywhere in North America. The National Museum contains examples from Puebla, in the State of Puebla, and from Jalapa, in the State of Vera Cruz, received from the Mexican Geographical Commission a few years ago.

Genus **PHYSA** Draparnaud.

Physa gyrina Say.

Numerous living examples.

Stone County, Mo., Vernon Bailey, July 7, 1892.

"Found in a creek near Marble Cave."

Physa mexicana Philippi.

Ten or more living specimens.

Houma, La.; Vernon Bailey.

These agree with the form to which Philippi gave the name *mexicana;* it appears to be a very globose variety of *heterostropha.*

SCUTIBRANCHIATA.

Section RHIPIDOGLOSSA.

Family HELICINIDÆ.

Genus **HELICINA** Lamarck.

Helicina orbiculata Say.

Numerous specimens.

Missouri, in Stone County, near Marble Cave; Vernon Bailey.

Common on the slopes of the hills.

In addition to the localities heretofore credited with this species, Mr. McDaniel has collected it in eastern Texas, in both Bell and Smith counties.

Writing of this form Mr. McDaniel says: "I found large numbers of this species in Bell County, Tex. The exact locality was on limestone bluffs on either side of Salado Creek. On one morning, just after a moderate rain, the whole face of the cliffs was sprinkled with them. On top of the bluffs they were found walking on twigs in the low brush and brambles and on trees 8 feet from the ground. Associated with them were found *Helix alternata* Say, and an occasional *Bulimulus Schiedeanus* var. *Mooreana* Pfr. This species also occurs in Floridà. I found a solitary living example under a cedar log between Tampa and Rocky Point when collecting in this region in 1869.

The following marine species were collected by Mr. Bailey on the shores of St. Louis Bay (Mississippi), Gulf of Mexico.

Class PELECYPODA.

Family CHAMIDÆ.

Genus **CHAMA** Bruguiere.

Chama arcinella Linné.

Valves only.

A widely distributed form, ranging geographically from Hatteras in the north, on and around the shores of Florida and the Gulf of Mexico to the Antillean region as far south as the island of Guadaloupe, West Indies. When perfect this is a peculiarly interesting and striking species.

Family VENERIDÆ.

Genus **DOSINIA** Scopoli.

Dosinia discus Reeve.

One example, fresh.

This species is quite common at many places on the eastern and gulf shores of Florida and at many other places in the Gulf of Mexico. Its northern limit is given as Virginia, by Dall,* and its southerly range as Vera Cruz.

I have found it abundant on the outer beach of Amelia Island near Fernandina, Florida, associated with *Tellina alternata* Say.

* In Bull. No. 37, U. S. National Museum; Cat. marine mollusks, etc., southeastern coast of the United States, etc.

Class GASTROPODA.

Family FASCIOLARIIDÆ.

Genus **FULGUR** Montfort.

Fulgur perversa Linné.

One good example.

This form has a wide distribution, and is one of the largest species of marine gastropods, the shell often attaining a length of 15 inches or more. It is found as far north as Cape Hatteras, on the Atlantic side, where it occurs between tide marks; thence southerly, along the coast, to and around the extremity of the peninsula of Florida, and on the shores of the Gulf of Mexico, in many localities, with Cuba as its southerly limit. At many places within the range of its distribution the animal (softer parts) is used as an article of food. It is, however, for the most part, tough and indigestible, in these respects rivaling the *abalones* or *Haliotis* of the Pacific coast, which are so largely used as food by the Chinese, and also exported to China in great quantities for culinary, or rather gastronomic purposes.

Family LITTORINIDÆ.

Genus **LITTORINA** Férussac.

Littorina irrorata Say.

Numerous specimens, living.

This also is an abundant and widely distributed species, living not only between tide marks, but frequently far above high-water line; it occurs on the shore of Rhode Island, thence along the shores southerly around Florida and the Gulf of Mexico to Texas and is credited to the West Indies and the island of Jamaica.

It is a solid and rather pretty form, and may be seen in localities where it occurs, crawling up or attached to the stiff, wiry sedge grass of the lagoons and salt meadows or marshes near the shore.

Family NATICIDÆ.

Subgenus **NEVERITA** Risso.

Neverita duplicata Say.

One dead beach-shell.

A common form at many places along the ocean and gulf shores from Massachusetts Bay to Texas; occurs also at Vera Cruz. I have collected numerous examples on Nahant and Chelsea beaches in the north, and on both coasts of Florida, and on the Florida Keys, in the south.

Lunatia heros Say, may be regarded as the Atlantic analogue of the West American or Pacific *Lunatia Lewisii*, though the latter attains a much larger size than *heros*. So *Neverita duplicata* may be considered

as the east coast analogue of the Pacific *N. Recluziana*, though the latter exhibits remarkable extremes of variation in many ways, and is much less constant in form than *duplicata*. I have collected both of these western forms at many places, from Puget Sound to San Diego. *L. Lewisii* is occasionally met with of extremely large size; it is the giant of the Naticas; it is frequently eaten by the Indians inhabiting the region bordering on the sound.

Family NERITIDÆ.

Genus **NERITINA** Lamarck.

Neritina reclivata Say.

Numerous living examples.

Dall gives the distribution of this species, as St. Augustine and both coasts of Florida, Texas, and the West Indies to Jamaica, the latter place being its southerly limit so far as known at the present time. Wherever found it is usually quite abundant. It is a rather pretty and well characterized species. It is quite common around the mouth of Hillsboro River where the stream flows into the bay near Tampa.

Class CEPHALOPODA.

Family SPIRULIDÆ.

Genus **SPIRULA** Lamarck.

Spirula peronii Lamarck.

One example, shell.

This is a pelagic species and its shells are found, sometimes in vast numbers, after storms or high winds, cast up on the beaches. The shells which are internal, are quite common in collections, and are often sold and used for fancy shellwork, but complete and perfect examples, animal, shell and all, are rarely met with in the museums.

WASHINGTON, D. C., *November 15, 1893.*

ON THE RELATIONSHIPS OF TAYLOR'S MOUSE, SITOMYS TAYLORI.

BY

FREDERICK W. TRUE,

Curator of the Department of Mammals.

In 1887, Mr. Oldfield Thomas described a very small mouse from San Diego, Texas, under the name of *Hesperomys* (*Vesperimus*) *taylori.** Later he gave a full description of it under the name of *Cricetus* (*Vesperimus*) *taylori.*†

For many years the National Museum possessed no examples of this interesting little species except a mutilated skin in alcohol, but on two occasions since 1887 it has received some complete specimens in alcohol from Mr. William Taylor, in whose honor the species was named.

This mouse is readily distinguishable from other American field-mice, as Mr. Thomas has pointed out, by its small size and nearly uniform coloration.

Mr. Thomas placed it unhesitatingly in the subgenus *Vesperimus*, and remarked "no detailed comparison is needed of this little mouse with its nearest allies." I propose to show, however, that it possesses characters intermediate between those of *Vesperimus* and *Onychomys*, and is typical of neither.

Dr. C. H. Merriam, in 1889, raised the subgenus *Onychomys* of Baird to the rank of a genus, giving as the principal characters the following:‡

1. Anterior upper molar with three external and two internal cusps. Last lower molar subcircular in outline.
2. "Coronoid process of mandible well developed, rising high above the condylar ramus and directed backward in the form of a large hook."
3. Nasals wedge-shaped behind.
4. Body stout and heavy; tail short and thick.
5. Hind feet with four phalangeal tubercles only.

These characters are contrasted with those of *Hesperomys* § (especially subgenus *Vesperimus*), in which the first upper molar has three cusps on each side, the last lower molar is somewhat elongated, the coronoid process is very short, the nasals are truncated behind, the tail is long, and the hind feet have six tubercles.

*Ann. & Mag. Nat. Hist., 5th ser., XIX, 1887, p. 66.
† Proc. Zoöl. Soc., London, 1888, p. 446.
‡ North Amer. Fauna, 2, 1889, p. 3.
§ = *Sitomys.*

Upon examining critically specimens of *Sitomys taylori*, I find that a different combination of characters exists. Thus, the anterior upper molar has three cusps on each side, and the last lower molar is somewhat elongated, as in *Vesperimus*, but, on the contrary, the coronoid process is high and prominent, as in *Onychomys*. The nasals are truncated behind, as in *Vesperimus*. In the proportion of the length of the tail, however, the species is intermediate between the two subgenera. Thus, in *Onychomys* the average length of the tail, for all the specimens of the several species cited by Dr. Merriam in 1889 (except *O. longipes*), is 46 per cent. of the length of the head and body; the longest tail, 62 per cent., is found in *O. longicaudus*, and the shortest, 36 per cent., in *O. melanophrys*. The average for four specimens of *Sitomys* (*Vesperimus*) *leucopus* is 89 per cent., while in *S. taylori* it is 65 to 70 per cent.

The hind feet in *S. taylori* have six tubercles, as in ordinary *Vesperimus*, but some hairs are found on the anterior part of the soles as far as the base of the toes, and even under the toes themselves.

On account of the peculiar combination of characters mentioned above, I am disposed to regard *S. taylori* as the type of a separate subgenus, which may be termed *Baiomys*.

Baiomys, subgen. nov.

Ascending ramus of mandible short and erect. Condyle terminal. Coronoid process well developed, uncinate, and near the condyle.

Size very small, tail short. Plantar tubercles, six. Soles hairy.

With *Vesperimus* and *Onychomys*, this subgenus will form one section of the genus *Sitomys*. It is more closely allied to the former than to the latter. In *Vesperimus*, the nearest ally, as Mr. Thomas has pointed out, is *S.* (*Vesperimus*) *michiganensis*, which has many of the characteristics of *S. taylori*, but so far as regards the skull is typical of the subgenus to which it belongs.

NOTES ON THE NATURAL HISTORY OF ALDABRA, ASSUMPTION AND GLORIOSO ISLANDS, INDIAN OCEAN.

BY

DR. W. L. ABBOTT.*

The atoll of Aldabra lies 220 miles northwest of the north point of Madagascar, in latitude 9° 25′ south, and longitude 46° east. It is about 22 miles long by 8 miles in extreme width, the long axis lying east and west.† It is entirely of coral formation, and forms an oval ring of land, broken at several points by channels, and inclosing a lagoon. The ring of dry land is widest at the southeast and northwest corners, where it is nearly 3 miles across. The Grande Terre, or main island, forms three-fifths of the circumference of the ring. It includes (from midway on the western side of the ring) the whole southern and eastern sides to a point on the north shore, being 35 miles long. It is separated by Pass Hourreau, 200 yards wide, from North or Middle Island. This is 12 miles long, forming the north shore as far as Grand Pass. This is the principal opening into the lagoon. It is 400 yards wide, and 8 to 10 fathoms deep. West of this lies Île Picard, or Northwest Island, forming the northwestern corner of the atoll. It is about 5 miles long. Between the south end of Île Picard and the northwest end of Grande Terre, lie half a dozen small islands and as many shallow channels. The lagoon is about 20 miles long and 6 miles in width. Excepting in the northwestern corner near Grand Pass and in a few channels, it is very shallow, half of it being nearly dry at low tide. Grand Pass is the only inlet deep enough to allow the passage of a large vessel, and through this the current runs with great rapidity, 5 to 7 knots, so that it is dangerous for sailing vessels except at the turn of the tides. At Pass Hourreau there is a narrow channel, through which a small vessel might pass. The inner or lagoon shore of the land is everywhere bounded by mangrove swamps, intersected by numerous channels. During the northwest monsoon a heavy swell rolls in through Grand Pass and breaks upon the reef within the lagoon. It is very dangerous to boats at such times, and the pass can not be traversed. There are numerous islands scattered about the lagoon, the longest being Île Sepoy, about 5 miles from Grand Pass and directly opposite to it, and Île Michel, opposite to Pass Hourreau, and close to the southern side

* Edited by Frederick W. True, with the assistance of other curators of the Museum. No identifications of species were included in Dr. Abbott's manuscript.

† The island was completely surveyed by H. M. S. *Alert*, in 1882.

of the lagoon. There are hundreds of other smaller islets, varying in size from a few acres to a few square yards.

The atoll is entirely of coral formation. Darwin, in his "Coral Reefs," relying principally on the reports of Capt. Moresby, did not regard it as a true atoll. The rocks of which it is composed were said to be "vitrified." The rock certainly resembles lava in its outward appearance: but it is easily broken, and the fracture displays a white interior and numerous fossil corals that are in a scarcely altered state. The rock gives a peculiar ringing sound when struck.

The principal difference between Aldabra and other coral islands is, that it seems to be of very ancient formation and has undergone an elevation of 15 to 20 feet. The island is flat, composed almost entirely of naked coral rock, rough and jagged, completely honeycombed in every direction with pits and fissures. Scarcely any soil exists, excepting where a small quantity of rich mold, formed by decomposing coral, has accumulated in hollows of the rock. The sea-face is an overhanging cliff of rock, but in a few places, especially on Île Picard and on the west coast, are sandy beaches and low sand-hills. Upon the south coast are Dune Jean Louis and Dune du Mêche, sand hills, which reach 65 feet above sea level—the highest points in Aldabra.

Nearly the whole surface is covered with a dense, almost impenetrable scrub of tangled bushes. No large trees now exist except the mangroves, which attain a height of 60 feet and a diameter of a foot or more. Formerly some large trees existed, as shown by the decaying stumps and fallen logs, occasionally 2 feet in diameter, still to be found upon Île Picard. In some places the larger mangroves are dead over areas of several acres. The disappearance of the larger trees can only be attributed to a diminution in the rainfall.

The supply of fresh water is very scanty, only obtainable in hollows in the rock, except at one place near the southeast corner of Grande Terre. Here there is a sort of spring, filling a hollow in the rock 6 by 2 feet, and 5 feet deep. This seems to drain a considerable area, as the level of the water can not be appreciably lowered by baling out. The water is of poor quality.

The rainfall is scanty and very irregular. Sometimes many months elapse during which not a drop of rain falls, and, on the other hand, 6 inches have been registered in a single night.

The islets in the lagoon are of very peculiar form, generally more or less mushroom-shaped. The level of their flat summits is a few feet

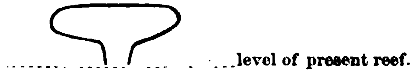

FIG. 1.—Section of an islet in the lagoon.

above that of spring tides. They are evidently the remains of the ancient floor of the lagoon. All the other parts having been cut away by the action of the water, the sides of all are undermined, and the smaller frequently present a very perfect mushroom-shape, as shown

in the accompanying figure. Sometimes the top is 30 feet in diameter, perched upon a support of 5 or 6 feet in thickness.

As before stated, the island is full of pits. These are often 20 to 30 feet in diameter and as many feet deep, and are full of salt water at high tide. Near the western end of the floor of the lagoon is a large hole, through which the water spouts up as the tide rises. This opening doubtless communicates with the sea outside through subterranean passages, and as the tide outside the lagoon is one or two hours in advance of that inside, this phenomenon is easily accounted for.

The currents sweep with great rapidity through the lagoon, especially near the channels, but in some of the calmer corners, particularly in the southwest, the bottom is covered with a layer of fine white mud, similar to that described by Darwin at Keeling atoll.

The average temperature on the island during October was 76° in early morning and 84° during the day. After the monsoon changed, early in December, it became much damper and warmer—up to 90° in the shade at 2 p. m. During October and November we had no rain, the vegetation became quite dried up, and mosquitoes were absent. In December about 15 inches of rain fell; vegetation awakened, nearly every plant put forth fresh green leaves and flowered. A more complete transformation could scarce be imagined. The desert island became a blooming garden filled with the perfume of flowers.

The most remarkable indigenous inhabitant of Aldabra is the gigantic land tortoise,* similar to those of the Galapagos group. They were formerly very abundant, but being easily caught and in great demand for their flesh, their numbers have been greatly diminished by the whalers and fishermen visiting the island. They are now protected (nominally) by the government of Seychelles, to which Aldabra belongs. They are still found upon Grande Terre and Île Nord, probably in considerable numbers, although I met with but few, as many parts of Aldabra are wholly inaccessible, owing to the rugged surface and dense jungle. They were completely exterminated upon Île Picard about twelve years since, but have recently been reintroduced by the present lessee of the island, Mr. James Spurs. At the present day they are more plentiful in the Seychelles than in their original habitat. They were brought many years since to the former islands, where they breed freely in confinement, and are much valued for food, being eaten at marriage feasts and on other festive occasions. It is the only remaining species of the gigantic land-tortoises that formerly inhabited Bourbon, Mauritius, and Rodriguez (and probably also Madagascar) at the time of their discovery. A single individual, probably of the Rodriguez species, still lives at Fort George Barracks, in Mauritius. The greatest enemy of the land tortoise is the common rat, which swarms upon Aldabra and eats the young as soon as they are hatched.

The only other land-reptiles upon Aldabra are a small lizard (*Able-*

* Probably *Testudo elephantina.* F. A. L.

pharus pœcilopleurus) and two geckos (*Hemidactylus mabouia* and *Phelsuma abbotti**).

Turtles are plentiful. Many thousands annually ascend the sandy beaches to deposit their eggs. Tortoise-shell was formerly gathered in large quantities, but this fishery has been overworked and large "carré" are now scarce.

Mammals are represented by a large fruit bat (*Pteropus aldabrensis*, True), and two smaller bats.† Rats (*Mus decumanus*), probably from wrecked vessels, swarm everywhere, and are very destructive. Cats, probably from the same source, are common upon Grande Terre, where they have completely exterminated the flightless rail.

Land-birds are represented by fourteen resident and six accidental or visiting species; water-birds by twenty-four species. Doubtless many more occasionally visit the island from Madagascar and Africa.

The most interesting species of birds is the curious flightless rail (*Rougetius aldabranus*, Ridgway), the sole survivor of the numerous flightless birds that inhabited the Mascarine Islands at the time of their discovery. I fear the present species must follow their example, as their arch enemy, the cat, has already exterminated them from Grande Terre, and must sooner or later reach the other smaller islands of the group, where the rails as yet abound in great numbers. The other land-birds are apparently similar to, or identical with, Madagascar species.

Boobies of several species,‡ frigates (*Fregata aquila minor*), and various species of terns§ and sandpipers, abound.

A flamingo (*Phœnicopterus erythræus ?*) is found in considerable numbers. This is particularly interesting as having also existed in Mauritius at time of its discovery.

Fish are not very plentiful in the neighborhood of the islands. Huge cocoanut-crabs (lobsters) abound, as also land-crabs.

Insects are not numerous either in species or individuals. Six or seven butterflies, a few moths, a dragonfly, a few beetles, some flies, and bees are found.|| Mosquitoes abound

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*New species described by Mr. Stejneger.

†One of these is *Nyctinomus pumilus*. F. W. T.

‡Only *Sula piscator* (Linn.) is represented in the collection made by Dr. Abbott.—R. R.

§ *Sterna bernsteini*, *S. fuliginosa*, *S. melanauchen*, *Anous stolidus* and *Gygis alba*.—R. R.

||Mr. Linell furnishes the following list of Aldabra insects received from Dr. Abbott:

Butterflies:

1. *Diadema misippus*, L. Both sexes taken; ♂, black with violet-shot white spots; ♀, brown with black and white wing-tips, closely imitating *Danais chrysippus*. The distribution of this species is remarkable. It is rare in America from South Florida through the West Indies to the Amazon region; more common in Africa (except the Mediterranean region) and through Southern Asia and the Malay Archipelago to New Holland.
2. *Junonia clelia*, Cram. Common in South and East Africa.

The islands are covered with dense scrub, mostly composed of shrubs 4 to 8 feet high. No large trees except mangroves now exist, and small plants are remarkably scarce. There are no ferns or orchids, but considerable quantities of Orchilla moss are gathered. Formerly "porché" and "bois rose" grew to considerable size, judging from the decaying stumps and logs. A few cocoanut trees exist, mostly upon Île Michel.

Aldabra is not permanently inhabited, but there are usually a few fishermen from Seychelles living there. The whole Aldabra group, including Aldabra, Astove, Assumption, and Cosmoledo, belongs to the British colony of Seychelles, and is leased by the Government for the turtle and tortoise-shell fishery.

ASSUMPTION ISLAND.

Assumption lies 20 miles southeast of Aldabra and is about 5 miles long by 1¼ miles wide. In its physical features it is much like Aldabra, but its surface is smoother and it is not so densely covered with scrub. A considerable part of the surface is covered with "champignon," as the rugged fossil coral rock of Aldabra is called. There are two large sand dunes upon the eastern shore, about 70 feet high, which are visible from a considerable distance. No fresh water exists, unless just after a rain, when a little collects in hollows in the rock. The animal life and vegetation is similar to that of Aldabra. The little flightless rail (*Rougetius abbotti*, Ridgway)* abounds, as well as most of the other land-birds found upon the latter island. Numbers of goats run wild, having been introduced many years since from Europa Island (in Mozambique Channel).

GLORIOSO ISLAND.

Glorioso Island lies about 90 miles west-northwest of the north point of Madagascar (Cape Amber), and 120 southeast of Aldabra. It is

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3. *Lycæna telicanus*, Hüb. South Europe through East Africa to the Cape of Good Hope.

Dragonfly:

1. *Pantala flavescens*, Fab. A common East African species.

Myrmeleon. *Myrmeleon*, sp.

Mantid:

1. *Polyspilota variegata*, Oliv. An East African species.

Beetles:

1. *Oxythyrea amabilis*, Schönh.; var. Smaller than the continental forms.
2. Small scarabæid—undetermined.
3. Small longicorn—undetermined.

Wasps:

1. *Sphex*, sp.
2. *Monedula*, sp.

Other diptera:

Odontomyia, sp. F. W. T.

* A different species from that of Aldabra, described in *The Auk*, for January, 1894.—R. R.

situated upon the south end of the Glorioso bank. The bank is about 8 miles long by 2 in width. Île du Lise lies at the north end of the bank.

Glorioso Island contains about 700 acres, being 1¼ miles long by 1 mile wide. It is partly covered with sand hills 50 to 60 feet high. Formerly it was almost entirely covered with a growth of "porché," "bois rose," "fouche" and other large trees, but at present many have been cut down. The soil is unusually fertile for an oceanic island, having been manured for ages by thousands of sea-birds. "Champignon," or fossil—coral rock, such as composes Aldabra, Cosmoledo, etc., exists in only a few spots, and the soil or sand is of fair depth. Large quantities of maize are grown. Water from wells is of poor quality. There are five species of land-birds, three of which, a sun bird,* *Zosterops*,† and a bulbul‡ are probably peculiar.

Common fowls run wild in the jungle in considerable numbers. They are very shy and not easy to shoot. Among sea-birds there is a booby, which seems to be peculiar to the island.§ They breed in large numbers upon the "fouche" trees, in company with frigates and common boobies.

Upon the neighboring small islet of Lise vast numbers of "Wide-awake" terns (*Sterna fuliginosa*) breed, together with "General" and "Capucin" boobies (*Sula cyanops* and *S. piscator*). A gecko (*Hemidactylus mabouia*) and two other lizards, (*Ablepharus gloriosus* Stejneger, *Zonosaurus madagascariensis*) are plentiful. Numbers of wild cats range the jungle, so that birds are far less numerous, individually, than in Aldabra.

* *Cinnyris souimanga.*

† *Z. madagascariensis.*

‡ *Ixocincla madagascariensis?*

§ Two species of boobies were collected by Dr. Abbott, *Sula cyanops* and *S. piscator*, but both of these are of very wide distribution.—R. R.

REMARKS ON JAPANESE QUAILS.

BY
LEONHARD STEJNEGER.

When writing my remarks on the Japanese quails recently sent me by Dr. Ijima (Proc. U. S. Nat. Mus., XVI, 1893, p. 623) I had not yet seen Mr. Oglivie Grant's "Notes on the Genus *Coturnix*" (Ann. Mag. Nat. Hist. (6) x, 1892, pp. 166–173), in which he advances the theory, or rather announces as a demonstrated fact, that there are two species occurring in Japan (and other portions of eastern Asia) viz: *C. coturnix*, the typical European species, and *C. japonica*, which, in their purity, may be distinguished as follows:

a¹ Feathers on throat and chin short and rounded.
  b¹ A black band down the middle of the throat .... *C. coturnix* ♂
  b² No black band down the middle of the throat.
    c¹ Chin and throat white .... *C. coturnix* ♀
    c² Chin and throat dark vinaceous-cinnamon [dull brick-red, O. G.] *C. japonica* ♂ ad.
a² Feathers on throat and chin elongate and lanceolate.
  b¹ Entire throat white .... *C. japonica* ♀
  b² Middle of throat suffused with dark cinnamon-rufous...... *C. japonica* ♂ juv.

The multitude of specimens which do not fall within the limits I have here drawn, he disposes of by the following remark: "The intermediate forms are, as I shall presently show, undoubtedly the results of interbreeding." But I am sorry to say that he does not show this, for there is no discussion of the material upon which he bases his remarks, nor are we furnished with a list of his specimens with the accompanying data upon which we might be enabled to base an opinion as to the correctness of his conclusions. All he gives us is a bare assertion to the above effect, the essential part of which is as follows: "In Japan and China the migratory Quail (*C. coturnix*), as already pointed out, inhabits the same tract of country during the breeding season as *C. japonica*, and there can not be the slightest doubt that the two species frequently interbreed, with the result that all sorts of intermediate hybrids are produced. These intermediate plumages are most noticeable among the male hybrids. For instance, some have the dull brick-red throat of *C. japonica* and the black anchor-shaped mark of *C. coturnix*, others have only the upper two-thirds of the throat dull red and the lower third white, while again a third lot have, in addition, a black band down the center of the red part, and all kinds of intermediate stages between these three examples may be found."

It is evidently in order to meet the objection that rufous-throated males are often found in Europe that he makes the following remark: "Equally also, though of secondary importance, *C. coturnix* interbreeds freely with the red-throated resident race (*C. capensis*)* in South Africa and the islands surrounding the coast, and the results are seen in the many male birds from South Africa and Southern Europe, etc., in which the white parts on the sides of the head and throat are more or less suffused with the bright rufous chestnut of the resident bird."

But this is hardly more than a postulate, and it is, in fact, somewhat difficult to see how such a hybridization can take place between a resident species and a subspecies (and he calls them only "races"). the results to be found both among the residents and the migrants, The facts are that these so-called intermediates between *C. capensis* and *C. coturnix* are not only found in South Africa and Southern Europe, but that they are quite common in Central Europe, as evidenced by the detailed description of the throat color and markings by Naumann (Naturg. Vög. Deutschl., VI, 1833, pp. 578, 579, and particularly pp. 580–581). From his remarks it will be seen that the male quails in Germany vary as much and almost in the same way as the Japanese and Chinese birds described by Mr. Ogilvie-Grant, and by him asserted to be hybrids.

Looking over my material I find nothing in it to contradict the supposition that the color and markings of the throat of the male Japanese bird is subject to as much individual variation as in the German bird, and I can see no reason for regarding these various plumages as "intermediate stages" or "hybrids." I think such a view also effectually disposes of the somewhat curious peculiarity that "these intermediate plumages are most noticeable among the male hybrids."

Mr. Ogilvie-Grant does not mention any specimens in which the supposed hybridism is expressed in an intermediate state of the enlongated throat feathers. On the other hand, in the males he regards the presènce of these specialized feathers as the sign of youth, in support of which he mentions the case of "a rather more mature male" in which "*one side of the throat* has lost the immature elongate feathers like those of the female and assumed the short, rounded, dull rufous feathers characteristic of the male adult," but all other data which would make it profitable to discuss the case are wanting.

I now turn to the material before me.

(1) U. S. Nat. Mus., No. 95980; ♂ ad.; collected by Blakiston at Sapporo, Yezo, May, 11, 1877. In coloration this specimen is exactly like the front figure of Fauna Jap. Av., pl. lxi, with the exception that the posterior half of the superciliary stripe is white and the anterior half spotted with white; the flank feathers are less marked with blackish; throat feathers, both in the middle and on the sides, short and rounded.

*I would suggest that the proper name of this subspecies is *Coturnix coturnix africana* (Schlegel) (see Fauna Jap. Aves, p. 103). There is no reference to this name in Mr. Ogilvie-Grant's synonymy.

(2) Imp. Mus., Tokyo, No. 2168; Province of Owari, Hondo; Mr. Ota coll.; no date. Coloration almost identical with the foregoing specimen, though with a faint blackish wash on the middle of the throat. Otherwise the similarity of the two specimens is so complete that I have no hesitation in pronouncing it of the same sex and age as the foregoing. Throat feathers in the middle short and rounded; on the sides perceptibly longer and narrower, though not pointed.

(3) Imp. Mus., Tokyo, No. 2170; Province of Owari, Hondo; no date. Coloration like 1 and 2, but chin, middle of throat, and first lateral branch of the throat patch black; flanks as in figure quoted above; throat feathers much as in 2.

The above three specimens thus appear to be fully adult summer males.

(4) U. S. Nat. Mus., No. 109409; ♂; Shimosa, Hondo; December 22, 1885. General coloration much as the above, but all light markings, including superciliary stripe, more strongly washed with buff; breast deeper ferruginous; chest feathers with a large chestnut spot in either web, but no black spots; feathers on middle of throat dull cinnamon-rufous, with broad white terminal margins; those on the sides of throat and on cheeks cinnamon-rufous with a white shaft streak, with terminal black spots on the cheeks. Middle throat feathers rounded; lateral ones elongated and pointed; a few of the latter still in their sheaths.

The richness of the coloration, especially that of the breast, leads me to believe that this is a fully adult male in, at least, its second winter.

(5) U. S. Nat. Mus., No. 91582; ♂; Yokohama, Hondo; April 4, 1883; P. L. Jouy coll. Considerably paler than any of the foregoing; throat and upper fore neck white, with a narrow dusky band down the middle of the throat, united below with a semicircular dusky line descending from the ear; lateral throat feathers edged with cinnamon-rufous; middle ones more or less suffused with the same color and tipped with whitish; a few blackish spots on the chest; all the throat feathers elongate and pointed.

(6) U. S. Nat. Mus., No. 95983; sex not given; A. Owston coll.; no date. Practically identical with foregoing, except that only lateral throat feathers are pointed, the median ones being short and rounded.

(7) U. S. Nat. Mus., No. 95982; ♂; Nagasaki, Kiusiu; January 1, 1877; F. Ringer coll. Like the foregoing, but throat band twice as broad, occupying the whole middle part and continued backward beyond the first semicircular line, though not reaching the second; throat feathers all strongly elongated and pointed.

(8) U. S. Nat. Mus., No. 114127; ♂; Fusan, Korea; November 21, 1885; P. L. Jouy coll. Like the foregoing, but throat and upper fore neck pure white, with a faint indication of a dusky band down the middle of the throat, caused by the dark bases of the feathers shining through the white tips; two semicircular black lines, the upper one imperfect on the median line; median throat feathers rounded, lateral ones moderately elongated, pointed.

(9) U. S. Nat. Mus., No. 114126; ♂; 40 miles from Seoul, Korea; November 11, 1883; P. L. Jouy coll. Like foregoing, with pure white throat, but simicircular lines scarcely indicated; middle throat feathers short and rounded, lateral ones elongated and pointed, but even less marked than in the foregoing; a number of these feathers, however, still in their sheaths.

The above six specimens (4–9) are unquestionably males, but I would not like to say anything concerning their age. Thus I can not bring myself to believe that 7, with its widely and distinctly black throat, is a very young bird, in spite of the fact that the feathers are more pointed and longer than in any of the others.

(10) U. S. Nat. Mus., No. 109410; ♀; Shimosa, Hondo; December 22, 1885. General coloration like 8 and 9, but throat suffused with buff and chest with numerous rows (at least five) of black spots; middle throat feathers rounded, lateral ones pointed, elongated.

(11) U. S. Nat. Mus., No. 95981; ♀; Yubuts, Yezo; September 13, 1882; Blakiston coll. Very pale and very little rust color on back; throat white, washed with buff; chest thickly spotted with black; flanks also heavily marked with black; lateral throat feathers pointed, middle ones less so; feathers appear considerably worn.

(12) In this enumeration of our Japanese and Korean specimens I have omitted No. 15849, collected during the Perry expedition by W. Heine, because it is unsexed and with no definite locality, besides being now somewhat soiled and faded. It seems to be most like No. 4 of this enumeration.

Our European series available at the present writing is very poor, but I wish to call attention to one specimen.

(13) U. S. Nat. Mus., No. 100345; ♂; Koncza, Transsilvania, Hungary; August 28, 1883; J. von Csato coll. Throat coloration almost identical with Ringer's Nagasaki specimen (7), except that the lateral feathers are not marked with cinnamon-rufous. The lateral throat feathers are perceptibly lengthened and pointed, fully as much as the Korean example (9).

In the above series there are hardly two specimens in which the throat feathers are of exactly the same size and shape. Mr. Ogilvie-Grant will probably maintain that this is exactly what we would expect in the hybrids. On the other hand, I would call attention to the fact that an intermediate shape is not at all coincident with an intermediate coloration or pattern. Specimen 7 is in this respect very instructive, as it unites the extreme elongation of the feathers of *C. japonica* with the extreme blackness of the throat of *C. coturnix*. Were we to accept the theory of hybridism, there would only be one pure-bred specimen (1) in the whole lot. This one is a typical *C. japonica*, and were we to identify our specimens by means of the key all, except No. 3, must be called *C. japonica*. The fact that a European specimen (13) also shows elongated pointed lateral throat feathers throws considerable doubt upon the value of this character as being diagnostic.

I have yet to see undoubted specimens of *C. coturnix* from Japan. Of course, that proves nothing, for Mr. Ogilvie-Grant may have seen them, but with his paper and the above-described series of specimens before me I can only say in regard to the occurrence of the two species in Japan "not proven."

Concerning the exact significance of the elongated throat feathers in the eastern birds, I have no well-founded theory to offer, but it seems to me as if there might be only a strong tendency toward the development of a "beard" in the eastern form, with an individual variation in this respect similar to the throat coloration.

It will probably remain for the Japanese field ornithologists to settle this question by the study of large series of fresh birds.

I hope that the above remarks may help them to fully understand the issue and consequently to collect intelligently.

NOTES ON BIRDS OF CENTRAL MEXICO, WITH DESCRIPTIONS OF FORMS BELIEVED TO BE NEW.

By
P. L. Jouy.

The following notes on the birds of central Mexico are the result of about twelve months' travel in that interesting country. Landing at Tampico on the 13th of October, 1891, a few days were spent in vigorous battle with mosquitoes and in courteous intercourse with the custodians of the custom house, who, thanks to the kindness of Señor Don Mateo Romero, passed all my luggage and collecting outfit through without examination. Few birds were seen, the only species worthy of mention being *Corvus mexicanus* and *Milvulus forficatus*, which were not observed at any other place. A deep narrow river empties into the Gulf at Tampico, giving access to the interior of the country by means of native dugout canoes. I was strongly advised by the United States vice-consul, Mr. Presley, to make the trip some 40 or 50 miles up the river, but fear of malaria and possibly "yellow jack" drove me to seek a safer climate. I was assured that it was perfectly safe to spend the winter months, that is from October to March, in the hot country by using ordinary precautions in regard to diet and drink. By working up and down the railroad considerable country could be covered with little loss of time.

Eighteen hours by the Mexican Central Railroad brings the traveler through the tropics, where nature is most luxuriant, up through cooler regions, across dashing mountain streams, through magnificent gorges, and, finally, across arid plains to the city of San Luis Potosi, the capital of the State of the same name. This, one of the largest and most important cities of Mexico, has unrivaled railroad facilities, being on the direct line of the Mexican National Road, running north and south, and is the western terminus of the Tampico branch of the Mexican Central. It also connects with the west by means of the Aguas Calientes branch of the Mexican Central. It is thus easy to reach the surrounding country, and, although the immediate neighborhood of the city is uninviting, yet an hour's travel in almost any direction takes the traveler into sparsely-wooded or hilly country, where collecting is possible.

Having paid my respects to the governor, Gen. Don Carlos Diez Gutierrez, and presented my letters and credentials, I received, through

his kindness, a general letter of introduction from him to all officials and others in the State, which proved of great service to me.*

From the city of San Luis, therefore, as headquarters, a number of trips were made from time to time. One to Charcas, in the northern part of the State, established the habitat of *Aphelocoma cyanotis*. Through the courtesy of Señor Don Xavier Espinosa, I was enabled to visit the hacienda Augostura, belonging to his family, which lies near the station of San Bartolo on the Tampico Line; here a new form of *Basileuterus rufifrons* was obtained, together with other varieties. *Grus mexicana* was here numerous in December. Several species not elsewhere obtained were collected at Solidad Don Carlos, a suburb of San Luis; also at Ahualulco, a station 24 miles from the city on the Aguas Calientes branch. Before leaving San Luis a trip was made to Lake Patzcuaro, in Michoacan, where fresh specimens of that interesting bird, the Mexican Jaçana, were obtained and forwarded to Washington, where they were mounted into a striking group for the U. S. National Museum Exhibit at the World's Columbian Exposition.

From January 9 to July 12, 1892, was spent in or near the city of Guadalajara, from whence numerous expeditions were made into the country. The Barranca Ibarra, a favorite collecting ground, lay about half a day's journey north of the city. This beautiful gorge, descending abruptly 1,500 feet, gave access to a quite varied and tropical fauna and flora. Here grew and were cultivated the pineapple, banana, and the mango; and here also the coffee plant flourished; many species of birds found here were never seen on the plateau above, and collecting would have been ideal if some of the tropical insect pests had not also entered into this paradise.

Other trips made from Guadalajara were to the falls of Juanacatlan, the "Niagara of Mexico," to Lake Chapala, reached from the station Atequiza, where I found unaccountably poor collecting, and also to the hacienda El Molino, which I visited through the kindness of Señor Don José Maria Negrete. This place, reached from the station Negrete, is probably the best locality for the naturalist near Guadalajara. A large, semi-wild garden planted with a great variety of trees and shrubs, and well watered by means of irrigating ditches, proved to be a great attraction for birds of all kinds. The proprietor, a gentleman who had traveled in nearly all lands, was also a great lover of birds, and kept several magnificent living specimens of the rare *Grus americana*, said to have been taken in the country, as an ornamental feature of his place.

In the latter part of March a trip was made on horseback south of

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*In no country are letters of introduction more valuable than in Mexico. The proximity to our wildest borders and the ease of ingress has flooded the country with the worst varieties of tramps and adventurers, until the oft-deluded native has come to regard all foreigners with suspicion. The traveler intending to spend any length of time in Mexico will, therefore, do well to provide himself with credentials.

Guadalajara, through the town of Zapatlan, to a place known as San Marcos, in the southern part of the State of Jalisco, and on the east base of the volcano of Colima. In this locality and in the neighboring Barranca Veltran (or "Beltran," as it is commonly known), a number of species were seen for the first time.

These *barrancas*, or gorges, produced either by ages of erosion or else by volcanic agency, are often a mile, more or less, deep, and perhaps 3 or 4 miles across in places, narrowing down to the width of a small stream at the bottom; they are therefore rather precipitous, and as they lie in the direct line of travel they give scope for the engineer's abilities. The change from the comparatively barren plateau to tropical luxuriance is often so great that the effect is that of entering into one of nature's greenhouses, a grand forcing house, a score or more miles in length, sheltering what unknown treasuries for the botanist and zoölogist! Here are found such birds as *Dendrornis*, *Engyptila*, *Conurus*, and *Amazona*, besides numerous hummers and other tropical forms.

A few species are included in this list which were collected at Guaymas, on the Gulf of California, and also a few from the mountains in Sonora, 32 miles south of the border town of Nogales, notably *Parus wollweberi*, *Dendoica graciæ*, *Columba fasciata*, *and Cyanocitta macrolapha.*

It will be seen from the foregoing that most of the species enumerated are from the temperate table-land region most nearly corresponding to our own southern borders of Arizona and New Mexico and although many common tropical birds will be looked for in vain in this list, yet it is hoped that it will not prove the less valuable on that account.

Color notes of the iris and other soft and fading parts of specimens have in all cases been compared with the plates in Ridgway's Nomenclature of Colors, which is an indispensable companion of the field naturalist, and is likewise invaluable in determining the tints of feathers. I am also much indebted to the author for advice and aid in the identification of species. In conclusion, I take pleasure in acknowledging the extreme courtesy received from the officials of the Mexican Government in all parts of the country, who did everything in their power to further my objects. Through the interest of Señor Mariscal, at the request of Minister Ryan, I received an autograph letter from his excellency President Porfirio Diaz, introducing me to the favorable notice of the governors of all the provinces of Mexico. These gentlemen in turn, so far as I traveled, gave me letters current in their respective States, which did much to facilitate traveling in the country.

Family TURDIDÆ.

1. Catharus melpomene clarus, subsp. nov.

A comparison of two adult male birds from Jalisco with a series from Vera Cruz and Gutemala shows that the western bird is a clearly rec-

ognizable geographical race. It is a slightly larger and very much paler bird than the eastern form and has decidedly longer wings and tail. It may be recognized by the following description:

Catharus melpomene clarus, subsp. nov. Type, U. S. National Museum, No. 126627, ♂ ad. Barranca Ibarra, Jalisco, W. Mexico, May 13, 1892. P. L. Jouy, coll.

Above, head and back olive-brown, rump tawny-olive, tail slightly darker, wings tawny-olive, the inner webs of the primaries and secondaries abruptly dusky; the center of the under surface of the wings cream-buff (clay-color in *melpomene*). Breast and flanks pale olive-gray; throat, belly, and crissum pure white; a few feathers of the sides of the crissum tinted pale isabella-color.

Dimensions: Length (fresh specimen), 173^{mm}; wing, 86; tail, 74; tarsus, 33. Iris very dark brown; eyelids, angle of mouth, and inside of mouth, cadmium-orange; tarsi and toes pale yellow.

A very shy, elusive species, always found on or near the ground in deep shady woods.

This clearly marked form has apparently escaped the notice of both collectors and writers, as I find no mention of *Catharus melpomene* as a western Mexican bird, nor has a paler race been referred to by authors. As Prof. Baird has pointed out in Review of American Birds, page 7, Costa Rican specimens differ from east Mexican and Guatemalan examples in "the prevalence of a grayish olive shade in the back;" they are also a deeper, clearer gray on the breast and flanks, and average shorter tails. A larger series of specimens in spring plumage would probably show it to be a distinct race.

2. Merula tristis Swains.

A common bird in the Barranca Ibarra, near Guadalajara. Specimens taken March 9 and April 21. Only note heard was a single sharp chirp or alarm note.

Iris dark brown.

3. Myadestes obscurus occidentalis Stejn.

San Marcos, southern Jalisco, March 25.

This bird, popularly known as the *clarin*, is a familiar and highly prized cage bird all through the interior of Mexico. The finest clarins are said to come from the eastern part of the country from the State of Vera Cruz southward, *M. unicolor* being more highly prized as a singer than *M. obscurus*.

The song of this bird, impossible to describe, has the most sylvan character of any bird music I am acquainted with. It is the very essence of deep shady woods and falling water. Poured forth suddenly, it has a surprising tinkling metallic quality, mingled with flute-like warbling notes given in falling cadences. The song is not loud nor is it long sustained, but it has a character all its own.

The color characters given by Dr. Stejneger in Proc. U. S. N. M., IV, 1882, page 371, separating var. *occidentalis* and var. *insularis* from *M. obscurus* are shown by this specimen to be untenable, it having white tips to all the tail feathers, and also light edges to the tips of the innermost secondaries. The wing formula of the three birds, however, appears to be distinct. My specimen agrees with the type of *occidentalis* in having the forehead white.

4. **Sialia mexicana** Swains.

Taken in foothills, 25 miles west of Charcas, San Luis Potosi, in November. Common in the valleys at that time and in the mountains up to an elevation of 7,000 feet.

Iris dark brown.

Family MIMIDÆ.

5. **Melanotis cærulescens** (Swains.).

Taken in Barranca Ibarra, near Guadalajara, in March and April.

This bird, known as the *Mulato* by the Mexicans, is a very common cage bird all over the country. It is a very fair singer and mimic, and is much valued for its lively and familiar ways.

Iris deep reddish-brown.

6. **Harporhynchus curvirostris** (Swains.).

A very common species in the central part of the State of San Luis Potosi; it was taken at Ahualulco in October, and was found abundant in the valleys about Charcas in November. It seemed to be found exclusively in the valleys grown up with *Opuntias*, in the larger specimens of which it builds its nest. Iris chrome; upper mandible, dusky; under mandible, pale yellow; tarsi, pale yellowish; toes, dusky.

7. **Harporhynchus longirostris** (Lafr.).

Taken at hacienda Angostura, in southern part of State of San Luis Potosi, in December. Rather a shy bird and apparently not very common, as few specimens were seen.

Iris cadmium-orange.

Family SYLVIIDÆ.

8. **Regulus calendula** (Linn.).

A single specimen was taken at Soledad, San Luis Potosi, on November 27, but was apparently not at all common. Not seen elsewhere.

9. **Polioptila cærulea obscura** Ridgw.

Taken in the neighborhood of Guaymas in February.

Family PARIDÆ.

10. **Psaltriparus melanotis iulus**, subsp. nov.

SUBSP. CHAR.—Differing from true *P. melanotis* in having the back hair brown instead of "yellowish brown" (bistre); paler under parts, the ventral region being only very slightly tinged with buffy; bill larger and heavier but other dimensions apparently the same.

HABITAT.—Western Mexico (type No. 126630 U. S. National Museum, ♂ ad., Hacienda El Molino, Jalisco, June 15, 1892; P. L. Jouy).

An example from Guanajuato, collected by Prof. A. Dugès, agrees fairly well with the type except that being a very young bird it is darker above and has buff edgings to the wings and tail. The flanks are also tinged with vinaceous.

This form is apparently intermediate between *P. melanotis* and *P. lloydi* but is easily distinguished from the latter by its distinctly gray head and light, hair-brown, back. The dimensions of the bill are about the same.

11. **Parus wollweberi** (Bonap.).

Adult and young of this bird were taken at an elevation of 6,000 feet in the mountains, 32 miles south of Nogales in Sonora, June 18. They were in small flocks with full-grown young which they were tending very solicitously.

Bill lavender at the base, tip dusky, edges pale yellow; gape yellow; tarsi and toes lead color.

Family SITTIDÆ.

12. **Sitta carolinensis aculeata** (Cass.).

Taken 32 miles south of Nogales in Sonora, June 19, in the pines.

Family CERTHIIDÆ.

13. **Certhia familiaris mexicana** (Glog.).

Seen in the pines 32 miles south of Nogales, Sonora, June 19.

Family TROGLODYTIDÆ.

14. **Heleodytes brunneicapillus** (Lafr.).

Common everywhere in the arid plain region wherever the cactus is abundant. Taken at Ahualulco, near San Luis Potosi, in October, and found abundantly in suitable places in Jalisco. Its loud purring notes proclaiming its presence unmistakably wherever found. In habits this great wren acts more like one of the *Harporhynchi*, than one of its relatives. It builds its nest in the cactus (*Opuntia*), like *Harporhynchus*

curvirostris, and I have never seen it cock its tail over the back in the characteristic wren attitude.

15. **Thryophilus sinaloa** Baird.

This is the commonest species of wren at the Barranca Ibarra. Jalisco, where it was taken May 13. It affects deep, shady woods, and breeds in the thickets bordering the stream which flows at the bottom of the barranca. Iris burnt-sienna; under mandible lilaceous; tarsi and toes, lilac-brown.

Family MNIOTILTIDÆ.

16. **Helminthophila celata** (Say).

Common in the latter part of November at Soledad, San Luis Potosi.

17. **Dendroica virens** (Gmel.).

Common in Cuernavaca, Morelos, in September; specimen taken September 14.

18. **Dendroica auduboni** (Towns.).

Very common all winter about Guadalajara. Familiarly seen in the gardens and about the court-yards of the houses, searching for insects in the crevices of walls and among the plants.

19. **Dendroica dominica albilora** Baird.

Taken in Cuernavaca, Morelos, September 4.

20. **Dendroica graciæ** Coues.

Quite common in mountains 32 miles south of Nogales, Sonora. Specimens taken June 17. Exceedingly shy, keeping high up in the pines.

21. **Dendroica æstiva sonorana** Brewster.

Common in Cuernavaca, Morelos, in August and September. Specimen taken August 19.

22. **Sylvania pusilla pileolata** (Pall.).

Taken at the falls of Juanacatlan, Jalisco, January 31. Common in the willows near the banks of streams.

23. **Basileuterus rufifrons jouyi** Ridgway.

[Proc. U. S. Nat. Mus., xv, p. 119.]

Two specimens, male and female, of this new form were taken at the Hacienda Angostura, December 8. These were first seen in bushes overhanging a small stream. They had the quick, nervous movements of a *Geothlypis*, and uttered scolding notes when disturbed. Another specimen collected at the Barranca Ibana, Jalisco, May 11, is identical

in color with the type specimen. These versatile little birds seem to be of varying habits, and are found in all suitable places affected by warblers. Never found far from running water, they may be seen dodging in and out among the bushes on the banks of streams, or on the shady side of a barranca they will be seen gleaning a harvest of small game in the treetops.

24. Euthlypis lachrymosa (Bonap.).

Tolerably common in the Barranca Ibarra where it undoubtedly breeds. Specimen taken May 14. Of very shy, skulking habits, this bird is almost invariably found on or near the ground. Delighting, like a water-thrush, in shaded thickets near running streams, it affects boggy places and is very expert in dodging behind bushes when disturbed. It has the constant habit, when walking on the ground, of flirting the tail sideways.

Family VIREONIDÆ.

25. Vireo flavoviridis (Cass.).

Tolerably common in the Barranca Ibarra in May, where it was undoubtedly breeding.

Iris pale venetian-red; bill and feet plumbeous.

26. Vireo noveboracensis (Gmel.).

Taken at the Hacienda Angostura, San Luis Potosi, December 16. Iris, white.

Family LANIIDÆ.

27. Lanius ludovicianus excubitorides (Swains.).

Exceedingly common and abundant everywhere in the central plateau region. Taken at Soledad, near San Luis Potosi, in December. Fond of perching in a conspicuous place, it has taken kindly to the telegraph wires and may almost invariably be found on them. A nest seen on the border at Nogales on June 2 contained five eggs. It was placed in the center of a mesquite tree and about 6 feet from the ground. The nest was so loosely put together and so tangled in the thorny growth ot the tree that it could not be lifted out. It was composed of coarse grasses and sticks and lined with finer grasses and thickly and softly padded with the dried flowers of the amaranth.

Family TANAGRIDÆ.

28. Euphonia, sp.

A single specimen of one of these small birds was seen in the Barranca Ibarra, but could not be identified. It was dark metallic blue on the back and bright yellow on the under parts. It was only seen for a moment and then disappeared and was not observed again.

29. Piranga hepatica Swains.

Barranca Ibarra, near Guadalajara, March 10. Several specimens seen.

30. Piranga bidentata Swains.

An adult male was taken in the Barranca Ibarra, near Guadalajara, May 14. This is probably near its most northern range, and no other specimens were seen.

Family FRINGILLIDÆ.

31. Cardinalis cardinalis canicaudus Chapm.

Hacienda Angostura, San Luis Potosi, in December. Common in all suitable cover.

32. Pyrrhuloxia sinuata Bonap.

Collected at Ahualulco, in San Luis Potosi, October 28, but apparently not very common.

33. Guiraca cærulea eurhyncha Coues.

A common species throughout the central plateau region of Mexico; it was taken at the Hacienda Angostura, San Luis Potosi, in December, and was also found quite abundant in Jalisco. Iris, dark brown; upper mandible, dusky; lower mandible, dull lead-color.

34. Sporophila torqueola (Bonap.).

Apparently not very common. A pair were seen and taken at the Hacienda El Molino, Jalisco, June 12.

35. Passerina versicolor (Bonap.).

Taken at the Barranca Ibarra, March 10.

36. Amphispiza bilineata (Cass.).

Abundant in the hills near Guaymas in February.

37. Zonotrichia leucophrys intermedia Ridgw.

Fields and hedges around San Luis Potosi, November 20, abundant.

38. Spizella breweri Cass.

Abundant in small flocks in the fields among low bushes. Falls of Juanacatlan, Jalisco, January 31.

39. Junco cinereus (Swains.).

Quite abundant in small flocks in the mountains 25 miles west of Charcas, San Luis Potosi, at an elevation of 7,000 to 8,000 feet. Specimens taken November 13. They were found on the open sunny slopes of the mountains, feeding on the ground or in low scrubby growth.

Iris, chrome; upper mandible, dusky; under mandible, pale yellow; tarsi, pale yellowish; toes, dusky.

40. Pipilo fuscus Swains.

This is one of the commonest birds everywhere in central Mexico. Almost invariably found on the ground, or on low walls, in tangled, grassy places; it is particularly partial to hedges along the roadsides. Of familiar and inquisitive disposition, it is constantly intruding itself on the passer-by. Utilizing the runways of the ground squirrels it keeps dodging in and out, appearing and disappearing, to the confusion of the collector. Taken at Ahualulco and San Luis Potosi, October 28 and November 30.

41. Pyrgisoma rubricatum (Licht.).

Only seen at the Barranca Ibarra, near Guadalajara, May 11 and 13. This is essentially a ground species, and, although it was not exactly rare, it is a very shy bird and difficult to get. It was found almost exclusively around the head of the barranca on the bare hillsides and on the road leading down, but never descending any distance toward the warmer lower country.

Iris, reddish brown; tarsi and toes, pale brownish lilaceous.

42. Carpodacus cassini Baird.

Abundant in small flocks among the live oaks at an elevation of 7,000 to 8,000 feet. In the mountains 25 miles west of Charcas, San Luis Potosi, November 13.

43. Spinus psaltria mexicanus (Swains.).

First seen at Soledad, San Luis Potosi, November 27, in small flocks in cottonwood trees, also taken at the Hacienda El Molino, in Jalisco, June 13. This is the large form first described by Swainson from the table-land of Mexico, Real del Monte, and which ranges north to southern Texas. Average measurements of six specimens of this bird from southern Texas and northern Mexico give the following results: Wing, 2.60 inches; tail, 1.70; culmen, 0.40. Two other forms, apparently distinct and with different habitats, have been called *mexicanus* by various authors, but can readily be distinguished by their smaller size and the more brilliant coloring of the under parts. They may be distinguished as follows:

Spinus psaltria croceus, subsp. nov.

SUBSP. CHAR.—Differing from *S. mexicanus* in having the entire under parts a deep gamboge-yellow instead of pale canary-yellow; the white of the wing at the base of the primaries more restricted, and with less white on the tertials. Axillaries mainly jet black (axillaries gray, or gray narrowly streaked with black in *mexicanus*). Size smaller, average of four specimens from Costa Rica, Guatemala, and Panama give, for the wing, 2.42 inches; tail, 1.52; culmen, 0.37.

HABITAT.—Western Central America (type No. 53,839 U. S. National Museum, ♂ ad., Panama, J. McLeannan.

Spinus, species.

The species inhabiting the Peninsula of Yucatan resembles *croceus* very closely in size and general coloration, but has the axillaries *bright yellow* with black bases. This may prove to be a distinct form, but the absence of reliable material from that locality prevents me from arriving at any conclusion in regard to it.

Family ICTERIDÆ.

44. Icterus abeillei (Less.).

Two adult males of this species were taken June 10 and 12 at the Hacienda El Molino, Jalisco. They were apparently not very common and the female escaped notice.

45. Icterus wagleri Scl.

Two adult males taken in Barranca Ibarra, Jalisco, April 20, 22.
Iris dark brown; base of under mandible lead color; tarsi and toes dusky olive.

46. Icterus audubonii Giraud.

Two adult females taken at the Hacienda Angostura in San Luis Potosi, December 10 and 16.

47. Icterus cucullatus Swains.

One specimen, a young male, taken in the Barranca Ibarra, April 21.

48. Icterus pustulatus (Wagl.).

Taken in Barranca Ibarra, Jalisco, April 21.

49. Sturnella magna neglecta (Aud.).

Abundant in the salty meadows of southern Jalisco. Specimens seen seemed very pale in color.

50. Quiscalus macrourus Swains.

Taken at Saledad, near San Luis Potosi, November 30. Iris light yellow. Very abundant all through the central Mexican region. A noisy and familiar bird, it makes itself at home in all cultivated places, and is particularly abundant in the parks and gardens of the cities. It even invades the patios of the houses and steals the food from the domestic fowls.

Family CORVIDÆ.

51. Cyanocitta stelleri macrolopha (Baird).

Abundant in the mountains south of Nogales in Sonora. Frequenting the pine woods in small flocks, they are very noisy birds, cawing all the time, and moving about from place to place continually.

52. Aphelocoma cyanotis Ridgw.

This bird first described by Mr. Ridgway in his "Manual of North American Birds" from a very old specimen collected by John Taylor,

esq., in 1836, and labeled simply "*Mexico*," was taken in the mountains, 25 miles west of Charcas, San Luis Potosi, November 13. It was found tolerably abundant in small flocks among the live oaks at an elevation of 7,000 to 8,000 feet. Found in rather open sparsely-covered situations, it seemed to spend much of its time on the ground feeding on fallen acorns, its habits resembling the Arizona jay, and, like that species, it also has a rather weak voice.

53. **Calocitta colliei** (Vig.).

Only seen at the Barranca Ibarra, where specimens were collected March 9. This noisy, showy species was found in the lower sides of the barranca in small flocks of four or five. Very shy and wary and constantly on the wing, flying from place to place, they make the air ring with their loud, harsh cries.

There seems to be considerable difference in size between the sexes of this bird, the male being larger in every way. The crest of the male also differs from the female's in being longer, recurved, and tipped with white, while the female's is straight and tipped with blue.

54. **Corvus mexicanus** Gm.

This species, long supposed to be restricted to the west coast of Mexico, notably at San Blas and Mazatlan,* was taken near the gulf coast at Tampico, October 15, thus apparently extending the range of the bird clear across the country. Several specimens were seen in company with grackles (*Quiscalus macrourus*) feeding in a plowed field. Seen from a distance their glossy plumage corresponded so closely with that of the grackles that, at first sight, it was difficult to tell the two birds apart; of course closer inspection revealed their different proportions, but I believe that this circumstance, if it is a constant habit, of the crows being found in company with the grackles may have led to their being overlooked by collectors.

I did not observe this bird elsewhere, but I have no doubt that further investigations will show that the species has a much larger range than has been credited to it heretofore.

Family TYRANNIDÆ.

55. **Sayornis nigricans** (Swains.).

Very common in state of Jalisco in summer.

56. **Pitangus derbianus** (Kaup).

Abundant in the cottonwood trees in the outskirts of Guadalajara; its noisy, querulous notes were constantly heard. Taken at Agua Azul, Guadalajara, February 4.

Iris dark brown.

*Biologia Centrali-Americana, Aves, Vol. I, p. 488.

57. **Megarhynchus pitangua** (Linn.).

Barranca Veltran, southern Jalisco, March 24. Common in the tree tops at the bottom of the barranca. Not taken elsewhere.

Iris very dark brown.

58. **Pyrocephalus rubineus mexicanus** (Scl.).

Abundant everywhere in the arid valleys of Mexico, this bird is one of the most familiar and well known forms. Its brilliant color and showy habit of darting into the air render it very conspicuous wherever found. Taken 15 miles west of Chicas, in the state of San Luis Potosi, November 13.

59. **Empidonax griseus** Brewst.

Taken at Soledad, near San Luis Potosi, December 3.

60. **Empidonax hammondii** (Xantus).

Taken at the Barranca Ibarra, Jalisco, March 9.

61. **Empidonax wrightii** Baird.

Taken at Soledad, near San Luis Potosi, November 20; also at the Barranca Ibarra, Jalisco, March 9.

62. **Myiarchus mexicanus magister** Ridgw.

Common in cottonwood trees along river bottoms. Taken at Hacienda El Molino, Jalisco, June 10.

63. **Myiarchus lawrencii olivascens** Ridgw.

Barranca Ibarra, Jalisco, May 14.

64. **Milvulus forficatus** (Gmel.).

A single specimen of this bird was shot at Tampico, October 15. It was perched on a telegraph wire, and seemed to be very unsuspicious. It was not seen in any other locality.

Iris dark brown.

Family COTINGIDÆ.

65. **Platypsaris albiventris** (Lawr.).

A shy, silent species found in the tree tops. Of rather sluggish habits, they present a rather striking contrast to the vivacity of the fly-catcher. Only observed in the Barranca Ibarra, where a specimen was obtained May 13. Iris umber brown; bill and feet lead color.

Family DENDROCOLAPTIDÆ.

66. Dendrornis mentalis Baird.

Only met with at the Barranca Veltran, southern Jalisco, where it is apparently not very common, as only one specimen was seen. This was taken March 24.

Iris dark brown; upper mandible dusky olivaceous, under mandible lilaceous; tarsi and toes olive.

Family TROCHILIDÆ.

67. Cœligena clemenciæ Less.

Taken at Cuernavaca, Morelos, September 24.

68. Trochilus colubris Linn.

Very abundant at Cuernavaca, Morelos, during the whole of September.

69. Cyanomyia ellioti (Berl.).

A common species in the vicinity of Guadalajara; they were taken at Lake Chapala, February 19, and were found quite abundant at the Barranca Ibarra, where specimens were collected in March. A female from Chapala has the throat stained a dirty yellow from contact with the pollen of some plant. These specimens appear to differ from *violiceps* in having a longer and broader bill, as well as having a shining green tail instead of bronzy red, as in the latter species.

70. Cyanomyia violiceps Gould.

This species was quite abundant in Cuernavaca, Morelos, from the latter part of August to the first week in September, during which time quite a number of specimens were taken.

71. Amazilia beryllina (Licht.).

Taken at Cuernavaca, Morelos, September 3. Apparently not very common.

72. Iache latirostris (Swains.).

Taken at Hacienda Angostura, San Luis Potosi, December 10; also at the Barranca Ibarro, Jalisco, March 10, where it was a common species. Base of bill carmine.

73. Chlorostilbon auriceps Gould.

Two specimens of this rather rare species were taken at San Marcos, southern Jalisco, March 25. Other specimens seen at about the same time would indicate that this locality, the base of the volcano of Colima, was the proper habitat of the species.

Family CAPRIMULGIDÆ.

74. **Chordeiles texensis** Lawr.

Very common at Lake Patzcuaro, December 22, flying low over the water at dusk. Not observed elsewhere.

Family PICIDÆ.

75. **Dryobates scalaris bairdi** (Sol.).

Taken at Ahualulco, near San Luis Potosi, October 28. Apparently not very common, as a single pair only were seen. Not seen elsewhere.

76. **Sphyrapicus varius** (Linn.).

Very abundant near San Luis Potosi in November and December. Taken at Soledad November 30 and December 3.

77. **Melanerpes aurifrons** (Wagl.).

Very abundant in the State of San Luis Potosi, where it was taken at Ahualulco and Soledad, in October and November, and also at the Hacienda Angostura, in the eastern part of the State, in December.

78. **Melanerpes uropygialis** (Baird).

Taken in the Barranca Ibarra, May 14.

Family MOMOTIDÆ.

79. **Momotus mexicanus** Swains.

San Marcos, southern Jalisco, March 29. Only seen at one place, a tangled thicket near a small stream. They did not seem at all shy, but sat on a low branch of a tree and eyed one with mild curiosity, all the while uttering a soft, low note. A singular characteristic noticed was the prominence of the ear tufts, which in this species project, in life, from the sides of the head very conspicuously, and give the bird a very unusual and grotesque appearance.

Iris dull carmine.

Family ALCEDINIDÆ.

80. **Ceryle americana septentrionalis** Sharpe.

Very common on the borders of the lakes and all small streams throughout the country. Specimens taken at Hacienda Angostura, San Luis Potosi, and at Lake Chapala, Jalisco.

Family TROGONIDÆ.

81. **Trogon ambiguus** Gould.

Taken in pine woods at Agosto, en route from San Marcos to Atenquiqui, April 1. A few were seen at this place in the pine woods, where

they were very shy; also occasionally seen at the Barranca Ibarra. Iris very dark brown, eyelids orange; bill bright yellow.

Family CUCULIDÆ.

82. Crotophaga sulcirostris Swains.

Common in thickets in small flocks near Lake Chapala, Jalisco, in February.

83. Piaya mexicana Swains.

Taken at the Falls of Juanacatlan Jalisco, January 31, and the Barranca Ibarra, April 20. For such a large, showy bird, this is an exceedingly unsuspicious one. It is easily approached, and in fact seems to be unconscious of danger even after its mate has been killed. It has a note resembling that of a small woodpecker.

Iris carmine or crimson; bill apple green, slightly dusky at the base; inside of mouth blue-black; tarsi and toes plumbeous.

Family PSITTACIDÆ.

84. Ara militaris (Linn.).

Tolerably common at the Barranca Veltran, southern Jalisco; also found in the pine forests of Agosto. I was told that it had been taken as far north as Guadalajara, at the Barranca Ibarra, but I did not see it at that locality. This bird joins in the noisy evening flights of the parrots, flying very high and uttering piercing cries.

Iris yellow; naked skin around the eye carmine.

85. Conurus petzii (Wagl.).

Common in small flocks in the Barranca Veltran, southern Jalisco, but not met with elsewhere. Specimen taken March 24.

These birds readily become domesticated, and are familiar pets with the natives. They are seldom caged, except at night for protection, and soon learn to distinguish their master and to say a few words.

Iris naples yellow; naked skin around eye king's yellow; upper mandible flesh-tinted, sides of lower mandible dusky, middle portion horn color.

86. Amazona finschi (Scl.).

This is the most abundant species of the family found in southern Jalisco. Common in the Barranca Veltran, where specimens were taken March 24 and 27. During the day these birds are scattered in small flocks all over the country, feeding on the various wild fruits, but toward evening they assemble in flocks of thirty or more and seem to take delight in long flights up and down the barranca, screaming in noisy chorus all the while. Suddenly they swerve off their course and alight in a large tree and for a few moments all is silent, when, appar-

ently without cause, they fly forth and seek some other tree, only to repeat the performance which they keep up until darkness sends them to their final roosting place. Ordinarily stupid and easily approached, they seem to be unusually suspicious at nightfall and occasionally fly quite high, when their rapid powerful flight much resembles that of a wild duck. Inner ring of iris brown-ocher, central portion chrome, outer edge, orange; bill pale yellow, brightest on sides of upper mandible; naked skin around eye dusky lead color; toes lead color; nails dusky.

Family STRIGIDÆ.

87. **Strix pratincola** Bonap.

Specimen shot in a cultivated field at noontime. It had probably been disturbed at its roosting place and seemed to be in a dazed condition, and was easily approached.

Taken at Agua Azul, Guadalajara, February 4.

Iris very dark brown.

Family BUBONIDÆ.

88. **Bubo virginianus subarcticus** (Hoy).

Specimen taken in Guadalajara, May 30.

89. **Speotyto cunicularia hypogæa** (Bonap.).

A few specimens were seen in the State of San Luis Potosi, at the Hacienda Angostura. Their mounds were spread over a considerable portion of a barren plain, and although the weather was stormy and unauspicious, being in December, as soon as the sun came out they were seen standing on top of their little mounds, bowing gravely as one approached.

Family FALCONIDÆ.

90. **Circus hudsonius** (Linn.).

A common species in central Mexico. Specimen taken at Soledad, San Luis Potosi, November 27.

91. **Buteo borealis calurus** (Cass.).

Exceedingly abundant through the whole central region.

92. **Urubitinga anthracina** (Licht.).

This bird has a peculiarly heavy awkward flight and seems to be very stupid in comparison with other hawks. It has also a most peculiar voice. I was attracted from quite a distance by a curious harsh squawk which I at first took to be the note of a night-heron; following up the sound my surprise was great to see a large dark-colored hawk perched

on the branch of a tree and uttering, at frequent intervals, a harsh and prolonged cry like *Kā-ā-ā-āh, Kā-ā-ā-āh!* It was sitting about 20 feet from the ground and allowed me to approach quite closely, showing no sign of alarm. Apparently not very common as I saw no other specimens. Collected at the Hacienda El Molino, Jalisco, June 11.

Iris rich brown; cere and eyelids lemon-yellow; bill plumbeous, darker at the tip; gape chrome yellow; tarsus chrome.

93. Polyborus cheriway (Jacq.).

Very common in the valleys both in San Luis Potosi and in the State of Jalisco. Often seen in scattered troops of three or four individuals on the ground prowling around in search of dead bodies of small animals or other refuse.

Hacienda Angostura, San Luis Potosi, December 14.

Iris yellow; bill lead-color; cere and throat chrome-yellow; tarsi and toes bright chrome.

Family PELECANIDÆ.

94. Pelecanus californicus Ridgw.

Very abundant in the harbor of Guaymas, where specimens were taken in full plumage in latter part of February.

(Color notes of this species have been unfortunately mislaid.)

Family ARDEIDÆ.

95. Ardetta exilis (Gmel.).

Taken at Lake Patzcuaro, December 20.

96. Botaurus lentiginosus (Montag.).

Taken at Lake Patzcuaro, December 20.

97. Tigrisoma cabanisi Heine.

This bird, which is quite common in the streams of the lower part of the State of San Luis Potosi, shares with the land-otter the native name of "perro de agua," or water dog. This incongruous name is said to have been applied to the bird on account of the hoarse barking croak which the creature makes when disturbed.

Male, female and full-grown young were taken on the Rio Verde, at the Hacienda Angostura, December 9 and 15.

Iris, pale chrome; under mandible and cere, pale greenish yellow; throat, king's yellow; tarsi and toes, dusky greenish.

Family IBIDIDÆ.

98. Plegadis guarauna (Linn.).

Very common in all marshy places in the central table-land, also found about all small streams and lakes. Taken at Lake Patzcuaro, December 22.

Family ANATIDÆ.

99. Erismatura rubida (Wils.).

Taken near San Luis Potosi, November 14. Common in streams throughout the State.

A flock of ducks were frequently seen as late as the middle of May in the Barranca Ibarra, Jalisco, but they were very shy and no specimens were obtained. From their size I should judge that they were some species of *Anas*. Several species of ducks were common on Lake Chapala during the winter months the most abundant being *Dafila acuta*, *Aythya collaris*, *Anas boschas* and *obscura*(?). Grebes were also abundant and coots thronged the beaches.

Family COLUMBIDÆ.

100. Columba fasciata Say.

Specimens taken in northern Sonora, 32 miles south of Nogales, June 14. Inner portion of iris, pale yellow; outer edge, lilac; eyelids, maroon; bill, dull cadmium; tip, black; tarsi and toes, clear cadmium.

101. Melopelia leucoptera (Linn.).

A common species throughout central Mexico, it is much prized by the natives as a pet, and almost every hut shows a cage or two with its mournful occupants, hanging at the door. Its doleful song has been transposed by some poetical genius into the following refrain,—

Tu! Tu!
Qué quieres?
Qué quieres?
Quiero tu! Quiero tu!

You! you! What do I want? I want (or love) you! I love you!

Fresh colors are as follows: Iris, ochraceous-rufous; cere campanula-blue; tarsi and toes, dull maroon-purple.

102. Scardafella inca (Less.).

An abundant and familiar species everywhere. It has become semidomesticated and may be found at all times about gardens and roadsides. Specimens were taken at San Luis Potosi and Guadalajara in October, December, and June. Iris, dull orange; bill, dusky, tarsi and toes, pale flesh color.

103. Engyptila, sp.

Apparently not a common bird in the regions visited. A specimen was shot in the Barranca Veltran March 24.

Family PERDICIDÆ.

104. Cyrtonyx montezumæ (Vig.).

A beautiful specimen of this bird was seen in captivity at Guadalajara, and said to come from the neighborhood. It was exceedingly tame and very loquacious, answering its master's call and keeping up a continual piping as long as any attention was paid to it.

105. Callipepla squamata (Vig.).

Quite numerous in the rocky hills near San Luis Potosi, at Ahualulco; also brought into market by hunters at Guadalajara.

106. Callipepla gambeli (Nutt.).

Seen in cages in Guadalajara. Said to have been taken in the neighboring hills.

107. Colinus graysoni (Lawr.).

Common in the neighborhood of Guadalajara where it was frequently offered for sale by the hunters; also found in the State of San Luis Potosi, at the Hacienda Angostura. Specimens taken at the Hacienda El Molino, Jalisco, June 13.

Family GRUIDÆ.

108. Grus mexicana (Müll.).

This species was numerous in winter time at the Hacienda Angostura in San Luis Potosi, frequenting the cultivated fields, and were often seen in large flocks circling high in air, their loud "*Kr-r-r-r-ruk*" being distinctly heard when the birds were almost out of sight

109. Grus americana (Linn.).

Several living specimens of this magnificent bird were kept at the Hacienda El Molino by Señor José Maria Negrete, as one of the attractions of his place. They were quite tame and walked freely about, guarded by an aged peon with a staff, whose sole duty it was to feed them and drive them to and from their watering place.

Family JACANIDÆ.

110. Jacana spinosa (Linn.).

Abundant at Lake Patzcuaro, but not seen anywhere else. They seem to be scattered abundantly all around the margin of the lake, but are generally seen singly walking over the lily pads. At times, generally in early morning or late afternoon, small flocks of four or five individuals may be found on the beach feeding after the manner of waders. They are rather shy and difficult to kill, and have a noisy

cackling voice when they take flight. When standing in reeds or sedge, they frequently stretch the neck up straight on the lookout for possible danger. They have also a curious habit of stretching the wings and raising them up over the back until they meet, thus displaying to the best advantage the beautiful contrasting colors of the wing-feathers, which in this position are conspicuously visible for a long distance. On wounding one of these birds, I found that it was a very fair swimmer, and, when I overtook it in a boat, it dived with as much confidence as a grebe, and I never saw it again.

Adults and fully grown young were taken December 20.

Fresh colors of a female adult were as follows: Iris, very dark brown; bill and frontal lobe, king's yellow, the latter dusky ashy at base; base of bill dirty white, slightly dusky at juncture of yellow portion; tarsi and toes, dusky greenish, brighter at the joints; alar spines chrome.

Fresh colors of a male bird differed slightly, as follows: Iris, alar spines, and under mandible, dull yellow; frontal lobe, slightly greenish yellow; upper mandible, olive, dusky at the base and with a whitish spot at the angles of the mouth; tarsi and toes as in the female.

Family RECURVIROSTRIDÆ.

111. Himantopus mexicanus (Müll.).

In small flocks on the shores of Lake Patzcuaro, December 22. Very shy; a specimen shot had a tapeworm in its intestines. Iris, carmine (the pupil in this bird is so large that the iris is reduced to a mere line); tarsi, pink; joints, lilaceous; toes, dull orange; nails, seal brown; bill, purplish black.

Family SCOLOPACIDÆ.

112. Gallinago delicata (Ord).

Common in suitable places along marshy banks of streams in winter. Taken at Hacienda Angostura, San Luis Potosi, December 8. Two birds were discovered sleeping at noonday on a mossy bank, side by side, with their long bills tucked under their wings.

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